VACON

DRIVEN BY DRIVES

nxp/c frequency converters

user's manual

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AT LEAST THE FOLLOWING STEPS OF THE *START-UP QUICK GUIDE* MUST BE PERFORMED DURING THE INSTALLATION AND COMMISSIONING.

IF ANY PROBLEMS OCCUR, PLEASE CONTACT YOUR LOCAL DISTRIBUTOR.

Start-up Quick Guide

1. Check that the delivery corresponds to your order, see Chapter 3.
2. Before taking any commissioning actions read carefully the safety instructions in Chapter 1.
3. Before the mechanical installation, check the minimum clearances around the unit (Chapter 5.6) and check the ambient conditions in Chapter 4.2.
4. Check the size of the motor cable, mains cable, mains fuses and check the cable connections, read Chapters 6.2.2 to 6.2.7.
5. Follow the installation instructions, see Chapter 7.
6. Control connections are explained in Chapter 8.2.1.
7. If the Start-Up wizard is active, select the language of the keypad, the application you want to use and set the basic parameters asked by the wizard. Always confirm by pressing the *Enter button*. If the Start-Up wizard is not active, follow the instructions 7a and 7b.

7a. Select the language of the keypad from the Menu **M6**, page **6.1**. Instructions on using the keypad are given in Chapter 9.

7b. Select the application you want to use from the Menu **M6**, page **6.2**. Instructions on using the keypad are given in Chapter 9.

8. All parameters have factory default values. In order to ensure proper operation, check the rating plate data for the values below and the corresponding parameters of parameter group G2.1.

   - nominal voltage of the motor
   - nominal frequency of the motor
   - nominal speed of the motor
   - nominal current of the motor
   - motor cosφ

   Some options may require special parameter settings

   All parameters are explained in the All in One Application Manual.

9. Follow the commissioning instructions, see Chapter 10.
10. The Vacon NX_ Frequency Converter is now ready for use.

Vacon Plc is not responsible for the use of the frequency converters against the instructions.

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VACON NXC USER'S MANUAL

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1. SAFETY

ONLY A COMPETENT ELECTRICIAN MAY CARRY OUT THE ELECTRICAL INSTALLATION

1.1 Warnings

1	The Vacon NX frequency converter is meant for fixed installations only.
2	Do not perform any measurements when the frequency converter is connected to the mains.
3	Do not perform any voltage withstand tests on any part of Vacon NX. There is a certain procedure according to which the tests shall be performed. Ignoring this procedure may result in damaged product.
4	The frequency converter has a large capacitive leakage current.
5	If the frequency converter is used as a part of a machine, the machine manufacturer is responsible for providing the machine with a main switch (EN 60204-1).
6	Only spare parts delivered by Vacon can be used.
7	The motor starts at power-up if the start command is 'ON'. Furthermore, the I/O functionalities (including start inputs) may change if parameters, applications or software are changed. Disconnect, therefore, the motor if an unexpected start can cause danger.
8	Prior to measurements on the motor or the motor cable, disconnect the motor cables from the frequency converter.
9	Do not touch the components on the circuit boards. Static voltage discharge may damage the components.

1.2 Safety instructions

1	The components of the power unit of the frequency converter and all cabinet mounted devices are potentially **live** when Vacon NX is connected to mains potential. **Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.**
2	The motor terminals U, V, W and the DC-link/brake resistor terminals –/+ and all other mains devices are potentially **live** when Vacon NX is connected to mains, **even if the motor is not running**.
3	After disconnecting the frequency converter from the mains, wait until the fan stops and the indicators on the keypad go out (if no keypad is attached see the indicators on the cover). Wait 5 more minutes before doing any work on Vacon NX connections. Do not even open the cabinet door before this time has expired.
4	The control I/O-terminals are isolated from the mains potential. However, the relay outputs and other I/O-terminals may have a dangerous control voltage present even when Vacon NX is disconnected from mains.
5	Before connecting the frequency converter to mains make sure that the Vacon NX front and cable covers as well as the cabinet doors are closed.

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1.3 Earthing and earth fault protection

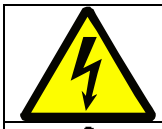
The Vacon NX frequency converter must always be earthed with an earthing conductor connected to the PE bar in the lower front side of the cabinet.

The earth fault protection inside the frequency converter protects only the converter itself against earth faults in the motor or the motor cable. It is not intended for personal safety.

Due to the high capacitive currents present in the frequency converter, fault current protective switches may not function properly.

1.4 Running the motor

Warning symbols
For your own safety, please pay special attention to the instructions marked with the following symbols:

	= *Dangerous voltage*
	= *General warning*
	= *Hot surface – Risk of burn*

MOTOR RUN CHECK LIST

	1	Before starting the motor, check that the motor is mounted properly and ensure that the machine connected to the motor allows the motor to be started.
	2	Set the maximum motor speed (frequency) according to the motor and the machine connected to it.
	3	Before reversing the motor make sure that this can be done safely.
	4	Make sure that no power correction capacitors are connected to the motor cable.
	5	Make sure that the motor terminals are not connected to mains potential.

2. INTRODUCTION

The Vacon NXC is a product range of free standing enclosed frequency converters for the high power range. The NXC is a modular product intended for use in all applications where reliability and high availability is appreciated.

This manual gives the basic information required to successfully perform installation and basic commissioning. Due to the high amount of options available, not all possible variations are described in this manual. For more information, refer to delivery-specific documentation. This manual assumes good competence in installation and commissioning skills.

In the All in One Application Manual you will find information about the different applications included in the All in One Application Package. Should these applications not meet the requirements of your process please contact the manufacturer for information on special applications.

Information on the installation of the drive in a cabinet can be found in manuals 'NXP Frequency Converters, IP00 Module Installation, Frames FR10 to FR14 (ud00908) as well as Frequency Inverter (UD01063) and Active Front End (UD01190) manuals.

This manual is available in both paper and electronic editions. We recommend you to use the electronic version if possible. If you have the **electronic version** at your disposal you will be able to benefit from the following features:

The manual contains several links and cross-references to other locations in the manual which makes it easier for the reader to move around in the manual, to check and find things faster.

The manual also contains hyperlinks to web pages. To visit these web pages through the links you must have an internet browser installed on your computer.

	In case you are in doubt about your ability to perform installation or commissioning, do not proceed. Contact your local Vacon partner for advice.
	For the NXC regenerative low-harmonic drive also see the AFE application manual.

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2.1 Manufacturer's declaration of conformity

Below you can find the Manufacturer's Declarations of Conformity assuring the compliance of Vacon NXP/C frequency converters with the EMC-directives.

VACON
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EU DECLARATION OF CONFORMITY

We

Manufacturer's name:	Vacon Oyj
Manufacturer's address:	P.O.Box 25 Runsorintie 7 FIN-65381 Vaasa Finland

hereby declare that the product

Product name:	Vacon NXP/C Frequency converter
Model designation:	Vacon NXP/C 0261 5.... to 2700 5.... Vacon NXP/C 0125 6.... to 2250 6....

has been designed and manufactured in accordance with the following standards:

Safety:	*FR9, FR10, FR12:*	EN60204-1 (2009) (as relevant)
	FR11, FR13/14:	EN61800-5-1 (2007)
EMC:		EN61800-3 (2004),

and conforms to the relevant safety provisions of the Low Voltage Directive (2006/95/EC) as amended by the Directive (93/68/EEC) and EMC Directive 2004/108/EC.

It is ensured through internal measures and quality control that the product conforms at all times to the requirements of the current Directive and the relevant standards.

In Vaasa, 24th of September, 2009

Vesa Laisi
President

The year the CE marking was affixed: 2002

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3. RECEIPT OF DELIVERY

Vacon NX frequency converters have undergone scrupulous tests and quality checks at the factory before they are delivered to the customer. However, after unpacking the product, check that no signs of transport damages are to be found on the product and that the delivery is complete (compare the type designation of the product to the code below).

Should the drive have been damaged during the shipping, please contact primarily the cargo insurance company or the carrier.

If the delivery does not correspond to your order, contact the supplier immediately.

In the small plastic bag included in the delivery you will find a silver *Drive modified* sticker. The purpose of the sticker is to notify the service personnel about the modifications made in the frequency converter. Attach the sticker to the equipment to avoid losing it. Should the frequency converter be later modified (option board added, IP or EMC protection level changed), mark the change in the sticker.

3.1 Type designation code

3.1.1 NX type designation

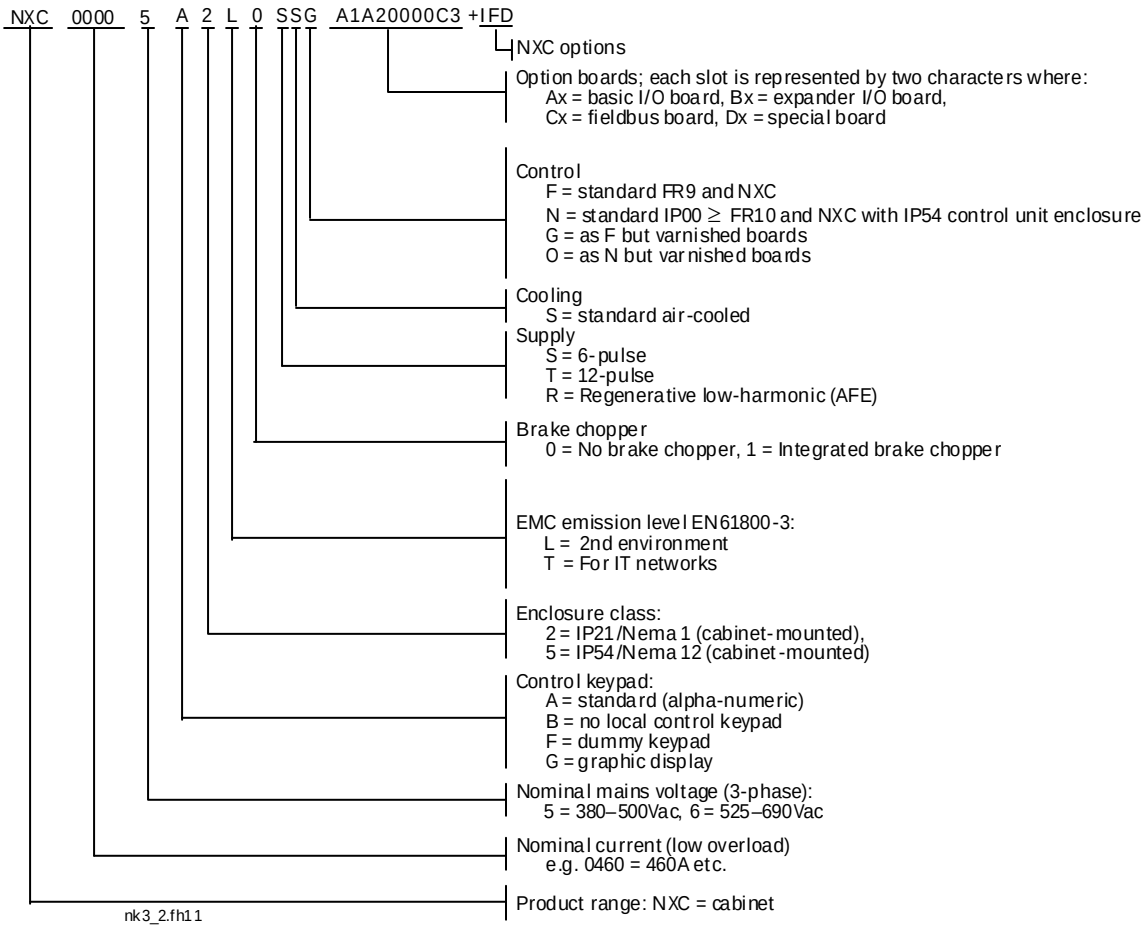
NXC 0000 5 A 2 L 0 SSG A1A20000C3 +IFD
NXC options
Option boards; each slot is represented by two characters where:
Ax = basic I/O board, Bx = expander I/O board,
Cx = fieldbus board, Dx = special board
Control
F = standard FR9 and NXC
N = standard IP00 ≥ FR10 and NXC with IP54 control unit enclosure
G = as F but varnished boards
O = as N but varnished boards
Cooling
S = standard air-cooled
Supply
S = 6-pulse
T = 12-pulse
R = Regenerative low-harmonic (AFE)
Brake chopper
0 = No brake chopper, 1 = Integrated brake chopper
EMC emission level EN61800-3:
L = 2nd environment
T = For IT networks
Enclosure class:
2 = IP21/Nema 1 (cabinet-mounted),
5 = IP54/Nema 12 (cabinet-mounted)
Control keypad:
A = standard (alpha-numeric)
B = no local control keypad
F = dummy keypad
G = graphic display
Nominal mains voltage (3-phase):
5 = 380–500Vac, 6 = 525–690Vac
Nominal current (low overload)
e.g. 0460 = 460A etc.
Product range: NXC = cabinet
nk3_2.fh11

Figure 3-1. Vacon NXC type designation code

3.2 NXC additional option codes

The NXC enclosure solution contains additional pre-engineered hardware options. These options are appended to the basic type code by using "+" codes. You will find the complete type code on the name plate of the unit. The most common NXC options are listed below:

3.2.1 Cabling (C-group)

+CIT	Input (mains) cabling from TOP	
+COT	Output motor cabling from TOP	

3.2.2 External Terminals (T-group)

+TIO	I/O+ aux terminals (35pcs)	X2
+TID	I/O+ double aux terminals (70pcs)	Double-decker terminals X2
+TUP	Separate terminals for 230VAC CV	X1

3.2.3 Input Device (I-group)

+ILS	Load switch	
+IFD	Fused disconnecting switch	With aR Fuses
+ICO	Contactor	
+IFU	Fused	With aR Fuses
+ICB	Moulded-case circuit breaker	

3.2.4 Main Circuit (M-group)

+MDC	DC-bus bar connection	Req. BSF converter hardware

3.2.5 Output Filters (O-group)

+OCM	Common mode choke	Ferrite rings 2x6
+ODU	dU/dt	
+OSI	Sine	

3.2.6 Protection Devices (P-group)

+PTR	Thermistor relay	PTB certified
+PES	Em. stop (cat 0)	DI3
+PED	Em. stop (cat 1)	DI6 (sys.appl.)
+PAP	Arc protection	
+PIF	Insulation fault sensor	For IT-networks

3.2.7 General (G-group)

+G40	400 empty cabinet	
+G60	600 empty cabinet	
+G80	800 empty cabinet	
+GPL	100mm base/plinth	For 400mm, 600mm or 800mm
+GPH	200mm base/plinth	For 400mm, 600mm or 800mm

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3.2.8 Auxiliary Equipment (A-group)

+AMF	Motor fan control	
+AMH	Motor heater feeder	
+AMB	Mechanical brake control	
+ACH	Cabinet heater	
+ACL	Cabinet light	
+ACR	Control relay	
+AAI	Analogue signal isolator	AI1, AO1, AI2
+AAC	Aux. contact (input device)	Wired to DI3
+AAA	Aux. contact (control voltage devices)	Chained to DI3
+ATx	Aux. Transformer 400-690/230VAC	x=1 (200VA) x=2 (750VA) x=3 (2500VA) x=4 (4000VA)
+ADC	Power supply 24VDC 10A	
+ACS	230VAC customer socket	With 30mA leak current prot.

3.2.9 Door Mounted (D-group)

+DLV	Pilot light (Control voltage on)	230VAC
+DLD	Pilot light (DO1)	24VDC, DO1
+DLF	Pilot light (FLT)	230VAC, RO2
+DLR	Pilot light (RUN)	230VAC, RO1
+DAR	Potentiometer for reference	AI1
+DCO	MC operation switch	0-1-START
+DRO	Local / Remote op. switch	Loc/Rem wired to DI6
+DEP	Emergency stop push-button	
+DRP	Reset push-button	DI6
+DAM	Analogue meter (AO1)	48mm, std scale 0-100%
+DCM	Analogue meter + current transformer	48mm, std scale 0-600A
+DVM	Analogue vltg meter with sel.switch	0, L1-L2, L2-L3, L3-L1

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3.3 Storage

If the frequency converter is to be kept in store before use make sure that the ambient conditions are acceptable:

Storing temperature	–40...+70°C
Relative humidity	<95%, no condensation

The environment should also be free from dust. If there is dust in the air the converter should be well protected to make sure dust does not get into the converter.

If the converter is to be stored during longer periods the power should be connected to the converter once in 24 months and kept on for at least 2 hours. If the storage time exceeds 24 months the electrolytic DC capacitors need to be charged with caution. Therefore, such a long storage time is not recommended.

If the storing time is much longer than 24 months, the recharging of the capacitors has to be carried out so that the possible high leakage current through the capacitors is limited. The best alternative is to use a DC-power supply with adjustable current limit. The current limit has to be set for example to 300...500mA and the DC-power supply has to be connected to the B+/B- terminals (DC supply terminals).

DC-voltage must be adjusted to nominal DC-voltage level of the unit (1.35*Un AC) and supplied at least for 1 hour.

If DC-voltage is not available and the unit has been stored de-energized much longer than 1 year consult factory before connecting power.

3.4 Maintenance

In normal conditions, Vacon NX frequency converters are maintenance-free. However, we recommend to keep the converter clean, e.g. by cleaning the heatsink with compressed air whenever necessary.

In IP54 units, the air filters in the door and in the roof should be cleaned or replaced regularly.

We also recommended to follow proactive maintenance schedule to ensure the highest possible utilization rate of the cabinet drive.

Maintenance interval	Maintenance action
12 months (if unit stored)	• Reform capacitors (see separate instruction)
6-24 months (depending on environment)	• Check I/O terminals • Check tightness of mains connection • Clean cooling tunnel • Check operation of cooling fan, check for corrosion on terminals, busbars and other surfaces • Check door and roof filters
5-7 years	• Change cooling fans: - main fan - fan of the LCL filter
5-10 years	• Change DC bus capacitors if DC voltage ripple is high

Table 3-1. Proactive maintenance schedule

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3.5 Warranty

Only manufacturing defects are covered by the warranty. The manufacturer assumes no responsibility for damages caused during or resulting from transport, receipt of the delivery, installation, commissioning or use.

The manufacturer shall in no event and under no circumstances be held responsible for damages and failures resulting from misuse, wrong installation, unacceptable ambient temperature, dust, corrosive substances or operation outside the rated specifications.

Neither can the manufacturer be held responsible for consequential damages.

The Manufacturer's time of warranty is 18 months from the delivery or 12 months from the commissioning whichever expires first (Vacon Warranty Terms).

The local distributor may grant a warranty time different from the above. This warranty time shall be specified in the distributor's sales and warranty terms. Vacon assumes no responsibility for any other warranties than that granted by Vacon itself.

In all matters concerning the warranty, please contact first your distributor.

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4. TECHNICAL DATA

4.1 Power ratings

4.1.1 Vacon NXP/C – Mains voltage 380—500 V

High overload = Max current I_S, 2 sec/20 sec, Rated overload current, 1 min/10 min
Following continuous operation at rated output current, rated overload current for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (IH)

Low overload = Max current I_S, 2 sec/20 sec, Rated overload current, 1 min/10 min
Following continuous operation at rated output current, rated overload current for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (IL)

Mains voltage 380-500 V, 50/60 Hz, 3~											
Frequency converter type	Loadability					Motor shaft power				Frame	Dimensions and weight* WxHxD/kg
	Low		High			400V supply		500V supply			
	Rated contin. current I_L (A)	Rated overload current (A)	Rated contin. current I_H (A)	Rated overload current (A)	Max current I_S	Low overload P(kW)	High overload P(kW)	Low overload P(kW)	High overload P(kW)		
NX_0261 5	261	287	205	308	349	132	110	160	132	FR9	606x2275x605/371
NX_0300 5	300	330	245	368	444	160	132	200	160	FR9	606x2275x605/371
NX_0385 5	385	424	300	450	540	200	160	250	200	FR10	606x2275x605/371
NX_0460 5	460	506	385	578	693	250	200	315	250	FR10	606x2275x605/403
NX_0520 5	520	572	460	690	828	250	250	355	315	FR10	606x2275x605/403
NX_0590 5	590	649	520	780	936	315	250	400	355	FR11	806x2275x605/577
NX_0650 5	650	715	590	885	1062	355	315	450	400	FR11	806x2275x605/577
NX_0730 5	730	803	650	975	1170	400	355	500	450	FR11	806x2275x605/577
NX_0820 5	820	902	730	1095	1314	450	400	560	500	FR12	1206x2275x605/810
NX_0920 5	920	1012	820	1230	1476	500	450	630	560	FR12	1206x2275x605/810
NX_1030 5	1030	1133	920	1380	1656	560	500	710	630	FR12	1206x2275x605/810
NX_1150 5	1150	1265	1030	1545	1620	630	560	800	710	FR13	1406X2275X605/1000
NX_1300 5	1300	1430	1150	1725	2079	710	630	900	800	FR13	1806X2275X605/1100
NX_1450 5	1450	1595	1300	1950	2484	800	710	1000	900	FR13	1806X2275X605/1100
NX_1770 5	1770	1947	1600	2400	2880	1000	900	1200	1100	FR14	2806X2275X605/2440
NX_2150 5	2150	2365	1940	2910	3492	1200	1100	1500	1300	FR14	2806X2275X605/2500

Table 4-1. Power ratings and dimensions of Vacon NX 6- and 12-pulse drives supply voltage 380—500V.

Note: The rated currents in given ambient temperatures are achieved only when the switching frequency is equal to or less than the factory default (automatic thermal management).

*The dimensions indicated are for the basic 6-pulse IP21 version of the converter cabinet. Some options may increase the width, height or weight of the cabinet. See the delivery-specific documentation for more details.

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4.1.2 Vacon NXC Regenerative low harmonic drives – Mains voltage 380—500 V

High overload = Max current I_S, 2 sec/20 sec, Rated overload current, 1 min/10 min
Following continuous operation at rated output current, rated overload current for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (IH)

Low overload = Max current I_S, 2 sec/20 sec, Rated overload current, 1 min/10 min
Following continuous operation at rated output current, rated overload current for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (IL)

Mains voltage 380-500 V, 50/60 Hz, 3~									
Frequency converter type	Loadability					Motor shaft power		Frame	Dimensions and weight* WxHxD/kg
	Low		High			400V supply			
	Rated contin. current I_L (A)	Rated overload current (A)	Rated contin. current I_H (A)	Rated overload current (A)	Max current I_S	Low overload P(kW)	High overload P(kW)		
NXC0261 5	261	287	205	308	349	132	110	FI9+FI9	1006x2275x605/680
NXC0300 5	300	330	245	368	444	160	132	FI9+FI9	1006x2275x605/680
NXC0385 5	385	424	300	450	540	200	160	FI10+FI10	1006x2275x605/700
NXC0460 5	460	506	385	578	693	250	200	FI10+FI10	1006x2275x605/700
NXC0520 5	520	572	460	690	828	250	250	FI10+FI10	1006x2275x605/700
NXC0650 5	650	715	590	885	1062	355	315	2xFI10+FI12	2006x2275x605/1400
NXC0730 5	730	803	650	975	1170	400	355	2xFI10+FI12	2006x2275x605/1400
NXC0820 5	820	902	730	1095	1314	450	400	2xFI10+FI12	2006x2275x605/1400
NXC0920 5	920	1012	820	1230	1476	500	450	2xFI10+FI12	2006x2275x605/1400
NXC1030 5	1030	1133	920	1380	1656	560	500	2xFI10+FI12	2006x2275x605/1400
NXC1150 5	1150	1265	1030	1545	1620	630	560	FI13+FI13	2206X2275X605/1950
NXC1300 5	1300	1430	1150	1725	2079	710	630	FI13+FI13	2206X2275X605/1950
NXC1450 5	1450	1595	1300	1950	2484	800	710	FI13+FI13	2206X2275X605/1950
NXC1770 5	1770	1947	1600	2400	2880	1000	900	2xFI13+FI14	4406X2275X605/3900
NXC2150 5	2150	2365	1940	2910	3492	1200	1100	2xFI13+FI14	4406X2275X605/3900
NXC2700 5	2700	2970	2300	3278	3933	1500	1200	2xFI13+FI14	4406X2275X605/3900

Table 4-2. Power ratings and dimensions of Vacon regenerative low-harmonic drives, supply voltage 380—500V

Note: The rated currents in given ambient temperatures are achieved only when the switching frequency is equal to or less than the factory default (automatic thermal management).

*The dimensions indicated are for the basic regenerative low-harmonic IP21 version of the converter cabinet. Some options increase the width, height or weight of the cabinet. Check the delivery specific documentation for more details.

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4.1.3 Vacon NXP/C 6 – Mains voltage 500—690 V

High overload = Max current IS, 2 sec/20 sec, Rated overload current, 1 min/10 min
Following continuous operation at rated output current, rated overload current for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (IH)

Low overload = Max current IS, 2 sec/20 sec, Rated overload current, 1 min/10 min
Following continuous operation at rated output current, rated overload current for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (IL)

Mains voltage 500-690 V, 50/60 Hz, 3~											
Frequency converter type	Loadability					Motor shaft power				Frame	Dimensions and weight* WxHxD/kg
	Low		High			690V supply		575V supply			
	Rated contin. current I_L (A)	Rated overload current (A)	Rated contin. current I_H (A)	50% overload current (A)	Max current I_S	Low overload P(kW)	High overload P(kW)	Low overload P(hp)	High overload P(hp)		
NX_0125 6	125	138	100	150	200	110	90	125	100	FR9	606x2275x605/371
NX_0144 6	144	158	125	188	213	132	110	150	125	FR9	606x2275x605/371
NX_0170 6	170	187	144	216	245	160	132	150	150	FR9	606x2275x605/371
NX_0208 6	208	229	170	255	289	200	160	200	150	FR9	606x2275x605/371
NX_0261 6	261	287	208	312	375	250	200	250	200	FR10	606x2275x605/341
NX_0325 6	325	358	261	392	470	315	250	300	250	FR10	606x2275x605/371
NX_0385 6	385	424	325	488	585	355	315	400	300	FR10	606x2275x605/371
NX_0416 6	416**	416**	325	488	585	400**	315	450**	300	FR10	606x2275x605/403
NX_0460 6	460	506	385	578	693	450	355	450	400	FR11	806x2275x605/524
NX_0502 6	502	552	460	690	828	500	450	500	450	FR11	806x2275x605/524
NX_0590 6	590**	649**	502**	753**	904**	560**	500**	600**	500**	FR11	806x2275x605/577
NX_0650 6	650	715	590	885	1062	630	560	650	600	FR12	1206x2275x605/745
NX_0750 6	750	825	650	975	1170	710	630	800	650	FR12	1206x2275x605/745
NX_0820 6	820**	902**	650	975	1170	800**	630	800**	650	FR12	1206x2275x605/745
NX_0920 6	920	1012	820	1230	1410	900	800	900	800	FR13	1406x2275x605/1000
NX_1030 6	1030	1130	920	1380	1755	1000	900	1000	900	FR13	1406x2275x605/1000
NX_1180 6	1180**	1298**	1030**	1463**	1755**	1150**	1000**	1100**	1000**	FR13	1406x2275x605/1000
NX_1500 6	1500	1650	1300	1950	2340	1500	1300	1500	1350	FR14	2406X2275X605/2350
NX_1900 6	1900	2090	1500	2250	2700	1800	1500	2000	1500	FR14	2806X2275X605/2440
NX_2250 6	2250	2475	1900	2782	3335	2000	1800	2300	2000	FR14	2806X2275X605/2500

Table 4-3. Power ratings and dimensions of Vacon NX 6- and 12-pulse drives, supply voltage 500—690V.

Note: The rated currents in given ambient temperatures are achieved only when the switching frequency is equal to or less than the factory default (automatic thermal management).

*The dimensions indicated are for the basic 6-pulse IP21 version of the converter cabinet. Some options increase the width, height or weight of the cabinet. Check the delivery specific documentation for more details.

** Maximum ambient temperature +35°C

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4.1.4 Vacon NXC Regenerative low harmonic drives – Mains voltage 525—690 V

High overload = Max current IS, 2 sec/20 sec, Rated overload current, 1 min/10 min
Following continuous operation at rated output current, rated overload current for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (IH)

Low overload = Max current IS, 2 sec/20 sec, Rated overload current, 1 min/10 min
Following continuous operation at rated output current, rated overload current for 1 min, followed by a period of load current less than rated current, and of such duration that the r.m.s output current, over the duty cycle, does not exceed rated output current (IL)

Mains voltage 525-690 V, 50/60 Hz, 3~									
Frequency converter type	Loadability					Motor shaft power		Frame	Dimensions and weight* WxHxD/kg
	Low		High			690V supply			
	Rated contin. current I_L (A)	Rated overload current (A)	Rated contin. current I_H (A)	50% overload current (A)	Max current I_S	Low overload P(kW)	High overload P(kW)		
NXC0125 6	125	138	100	150	200	110	90	FI9+FI9	606x2275x605/371
NXC0144 6	144	158	125	188	213	132	110	FI9+FI9	606x2275x605/371
NXC0170 6	170	187	144	216	245	160	132	FI9+FI9	606x2275x605/371
NXC0208 6	208	229	170	255	289	200	160	FI9+FI9	606x2275x605/371
NXC0261 6	261	287	208	312	375	250	200	FI10+FI10	606x2275x605/341
NXC0325 6	325	358	261	392	470	315	250	FI10+FI10	606x2275x605/371
NXC0385 6	385	424	325	488	585	355	315	FI10+FI10	606x2275x605/371
NXC0416 6	416**	416**	325	488	585	400**	315	FI10+FI10	606x2275x605/403
NXC0460 6	460	506	385	578	693	450	355	2xFI10+FI12	806x2275x605/524
NXC0502 6	502	552	460	690	828	500	450	2xFI10+FI12	806x2275x605/524
NXC0590 6	590**	649**	502**	753**	904**	560**	500**	2xFI10+FI12	806x2275x605/577
NXC0650 6	650	715	590	885	1062	630	560	2xFI10+FI12	1206x2275x605/745
NXC0750 6	750	825	650	975	1170	710	630	2xFI10+FI12	1206x2275x605/745
NXC0820 6	820**	902**	650	975	1170	800**	630	2xFI10+FI12	1206x2275x605/745
NXC0920 6	920	1012	820	1230	1410	900	800	FI13+FI13	1406x2275x605/1000
NXC1030 6	1030	1130	920	1380	1755	1000	900	FI13+FI13	1406x2275x605/1000
NXC1180 6	1180**	1298**	1030**	1463**	1755**	1150**	1000**	FI13+FI13	1406x2275x605/1000
NXC1500 6	1500	1650	1300	1950	2340	1500	1300	2xFI13+FI14	2406X2275X605/2350
NXC1900 6	1900	2090	1500	2250	2700	1800	1500	2xFI13+FI14	2806X2275X605/2440
NXC2250 6	2250	2475	1900	2782	3335	2000	1800	2xFI13+FI14	2806X2275X605/2500

Table 4-4. Power ratings and dimensions of Vacon regenerative low-harmonic drives, supply voltage 525-690V.

Note: The rated currents in given ambient temperatures are achieved only when the switching frequency is equal to or less than the factory default (automatic thermal management).

*The dimensions indicated are for the basic regenerative low-harmonic IP21 version of the converter cabinet. Some options increase the width, height or weight of the cabinet. Check the delivery specific documentation for more details.

** Maximum ambient temperature +35°C

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4.2 Technical data

Mains connection	Input voltage U_{in}	380...500V; 500...690V; –10%...+10% 380...500V;525...690V; –10%...+10% (regenerative drives)
	Input frequency	45...66 Hz
	Connection to mains	Once per minute or less (normal case);
Motor connection	Output voltage	0—U_{in}
	Continuous output current	Ambient temperature max. +40°C See Table 4-1 and Table 4-3.
	Overloadability	High: 1.5 x IH (1 min/10 min), Low: 1.1 x IL (1 min/10 min)
	Starting current	I_S for 2 s every 20 s
	Output frequency	0...320 Hz; (higher with special SW)
Control characteristics	Control performance	• Open Loop Vector Control (5-150% of base speed): speed control 0.5%, dynamic 0.3%sec, torque lin. <2%, torque rise time ~5 ms • Closed Loop Vector Control (entire speed range): speed control 0.01%, dynamic 0.2%sec, torque lin. <2%, torque rise time ~2 ms
	Switching frequency	**NX_5:** 1...6 kHz; Factory default 3.6 kHz * **NX_6:** 1...6 kHz; Factory default 1.5 kHz *
	Frequency reference Analogue input Panel reference	 Resolution 0.1% (10-bit), accuracy ±1% Resolution 0.01 Hz
	Field weakening point	8...320 Hz
	Acceleration time	0.1...3000 sec
	Deceleration time	0.1...3000 sec
	Braking	DC brake: 30% * T_N (without brake option); flux braking
Ambient conditions	Ambient operating temperature	–10°C (no frost)...+40ºC
	Storage temperature	–40°C...+70°C
	Relative humidity	0 to 95% RH, non-condensing, non-corrosive, no dripping water
	Air quality: - chemical vapours - mechanical particles	 IEC 721-3-3, unit in operation, class 3C2 IEC 721-3-3, unit in operation, class 3S2
	Cabinet surface treatment	Nanoceramic pretreatment. Anodic dipcoat-priming and textured powder-coating
	Altitude	100% load capacity (no derating) up to 1,000 m 1-% derating for each 100m above 1000; max. 3000m (690V max 2000m)
	Vibration EN50178/EN60068-2-6	Displacement amplitude 0.25 mm (peak) at 5...31 Hz Max acceleration 1 G at 31...150 Hz Use anti-vibration mountings under the drive if extra vibration resistance is required
	Shock EN50178, EN60068-2-27	UPS Drop Test (for applicable UPS weights) Storage and shipping: max 15 G, 11 ms (in package)
	Enclosure class	IP21/NEMA1 standard in entire kW/HP range IP54/NEMA12 option in entire kW/HP range

(Continues on next page)

*The rated currents in given ambient temperatures are achieved only when the switching frequency is equal to or less than the factory default. Thermal management might reduce the switching frequency.

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EMC (at default settings)	Immunity	Fulfils all EMC immunity requirements
	Emissions	EMC level L: EN 61800-3 (2004), Category C3 EMC level T: Low earth-current solution for IT-networks, EN 61800-3 (2004), Category C4 (can be modified from level L units
Safety		EN 50178 (1997), EN 60204-1 (1996), EN 60950 (2000, 3rd edition) (as relevant), CE, UL, CUL, EN 61800-5; (see unit nameplate for more detailed approvals)
Control connections (factory default I/O)	Analogue input voltage	0...+10V, R_i = 200kΩ, (–10V...+10V joystick control) Resolution 0.1%, accuracy ±1%
	Analogue input current	0(4)...20 mA, R_i = 250Ω differential; Resolution 0.1%, accuracy ±1%
	Digital inputs (6)	Positive or negative logic; 18...30VDC
	Auxiliary voltage	+24V, ±15%, max volt. ripple < 100mVrms; max. 250mA Dimensioning: max. 1000mA/control box
	Output reference voltage	+10V, ±3%, max. load 10mA
	Analogue output	0(4)...20mA; R_L max. 500Ω; Resolution 10 bit; Accuracy ±2%
	Digital outputs	Open collector output, 50mA/48V
	Relay outputs	2 programmable change-over relay outputs Switching capacity: 24VDC/8A, 250VAC/8A, 125VDC/0.4A Min. switching load: 5V/10mA
	Thermistor input (OPT-A3)	Galvanically isolated, Rtrip = 4.7 kΩ
Protections	Overvoltage trip limit Undervoltage trip limit	**NX_5**: 911VDC; **NX_6**: 1200VDC **NX_5**: 333VDC; **NX_6**: 460 VDC
	Earth fault protection	In case of earth fault in motor or motor cable, only the frequency converter is protected
	Mains supervision	Trips if any of the input phases is missing
	Motor phase supervision	Trips if any of the output phases is missing
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes
	Motor stall protection	Yes
	Motor underload protection	Yes
	Short-circuit protection of +24V and +10V reference voltages	Yes

Table 4-5. Technical data

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5. MOUNTING

5.1 Dimensions

The table below shows the dimensional drawing of the basic cabinet. Please note that certain NXC options will further affect the total width or height of the cabinet. Always refer to the delivery specific information for the exact dimensions.

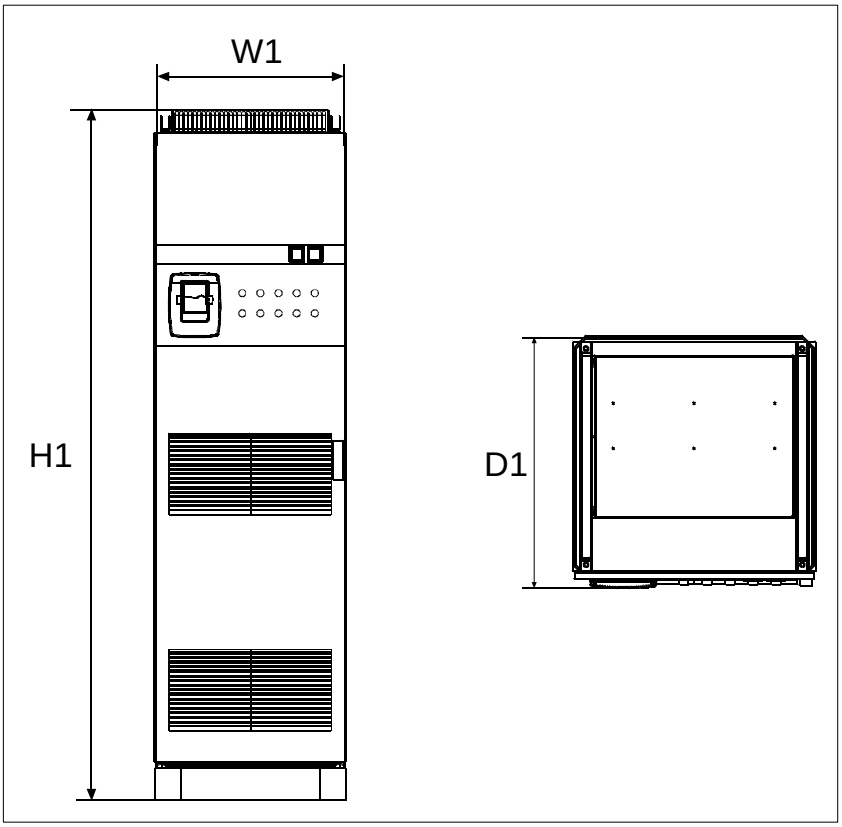

Figure 5-1. Basic cabinet dimensions

Type	Dimensions [mm] IP21			Dimensions [mm] IP54		
	W1	H1	D1	W1	H1	D1
0261—0520 5 0125—0416 6	606**	2275*	605	606**	2400*	605
0650—0730 5 0460—0590 6	806**	2275*	605	806**	2400*	605
0820—1030 5 0650—0820 6	1206**	2275*	605	1206**	2400*	605
1150 5	1406**	2275*	605	1206**	2400*	605
1300—1450 5	1606**	2275*	605	1606	2400	605
0920—1180 6	1406**	2275*	605	1406	2400	605
1500 6	2406	2275*	605	2406**	2400*	605
1770—2150 5 1900—2250 6	2806	2275*	605	2806**	2400*	605

Table 5-1. NXC 6-pulse drives cabinet dimensions

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Type	Dimensions [mm] IP21			Dimensions [mm] IP54		
	W1	H1	D1	W1	H1	D1
0385—0520 5 0261—0416 6	606**	2275*	605	606**	2400*	605
0590—0730 5 0460—0590 6	806**	2275*	605	806**	2400*	605
0820—1030 5 0650—0820 6	1206**	2275*	605	1206**	2400*	605
1150 5 0920—1180 6	1406**	2275*	605	1406**	2400*	605
1300—1450 5	2006**	2275*	605	2006**	2400*	605
1770—2150 5 1500—2250 6	2806**	2275*	605	2806**	2400*	605

Table 5-2. NXC 12-pulse drives cabinet dimensions

Type	Dimensions [mm] IP21			Dimensions [mm] IP54		
	W1	H1	D1	W1	H1	D1
0261—0520 5 0125—0416 6	1006**	2275*	605	1006**	2405*	605
0590—1030 5 0460—0820 6	2006**	2275*	605	2006**	2405*	605
1150—1450 5 0920—1180 6	2206**	2275*	605	2206**	2445*	605
1770—2700 5 1500—2250 6	4406**	2275*	605	4406**	2445*	605

Table 5-3. NXC regenerative drive low-harmonic cabinet dimensions

* the options +GPL or +GPH (Plinth) increase the height by 100mm or 200mm respectively
** some options, e.g. +CIT (Top input cabling +400mm), +COT (Top output cabling +400mm) and +ODU (output du/dt filter +400mm) affect the width of the cabinet

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5.2 Lifting the unit out of the transport packaging

The unit is delivered either in a wooden box or a wooden cage. The box may be transported either horizontally or vertically, while transportation of the cage in a horizontal position is not allowed. Always refer to shipping marks for more detailed information. To lift the unit out of the box, use lifting equipment capable of handling the weight of the cabinet.
There are lifting lugs on the top of the cabinet and these lugs can be used to lift the cabinet into an upright position and to move it to the place needed.

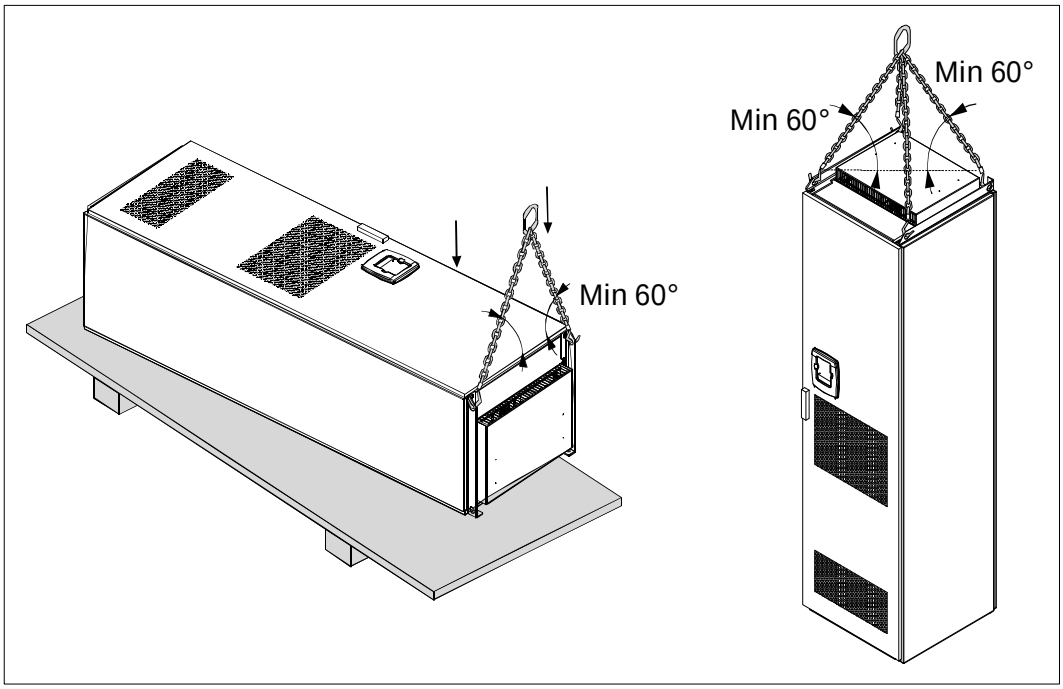

Figure 5-2. Lifting the unit

Note: Location of lifting lugs varies between different frames

Recycle the packaging material according to local regulations.

5.3 Fixing the unit to the floor or to the wall

The cabinet should always be fixed to the floor or to the wall. Depending on installation conditions, the cabinet sections can be fixed in different ways. There are holes in the front corners which can be used for fixing. Additionally, the rails on the top of the cabinet have fixing lugs for fixing the cabinet to the wall.

	Welding of the cabinet might risk sensitive components in the converter. Ensure that no grounding currents can flow through any part of the converter.

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5.3.1 Fixing to the floor and to the wall

In installations where the cabinet is mounted against the wall, it is more convenient to fix the top of the cabinet to the wall. Fix the cabinet in the two front corners to the floor with bolts. Fix the top part to the wall with bolts. Note that the rails and the fixing lugs can be moved horizontally to make sure the cabinet stands in a horizontal position. In converters consisting of more than one cabinet section, fix all sections in the same way.

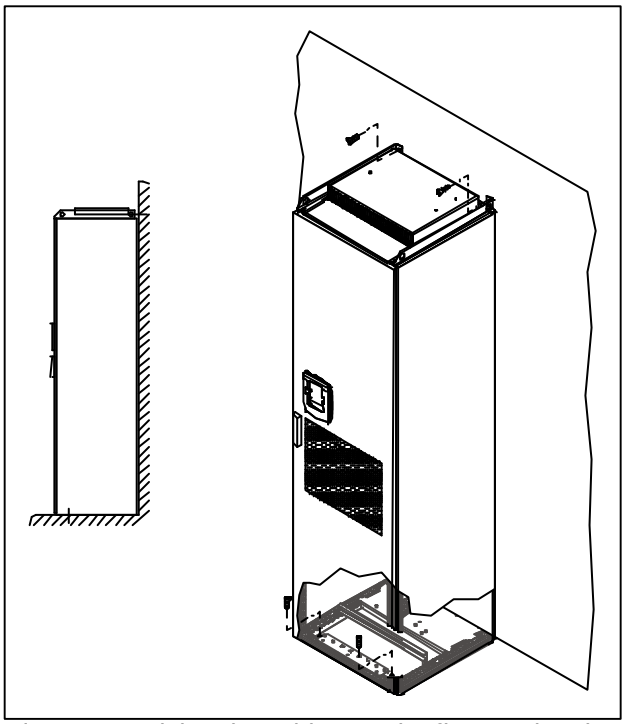

Figure 5-3. Fixing the cabinet to the floor and to the wall

5.3.2 Fixing to the floor only

Note: This option is not available for FR13 and bigger units. For fixing FR13 and bigger units see delivery specific documentation.

If bottom-only fixing is used, additional fixing brackets (Rittal part.nr. 8800.210) or equivalent are necessary. Fix the cabinet to the floor in the front with bolts and use the fixing brackets in the middle. Fix all cabinet sections in the same way.

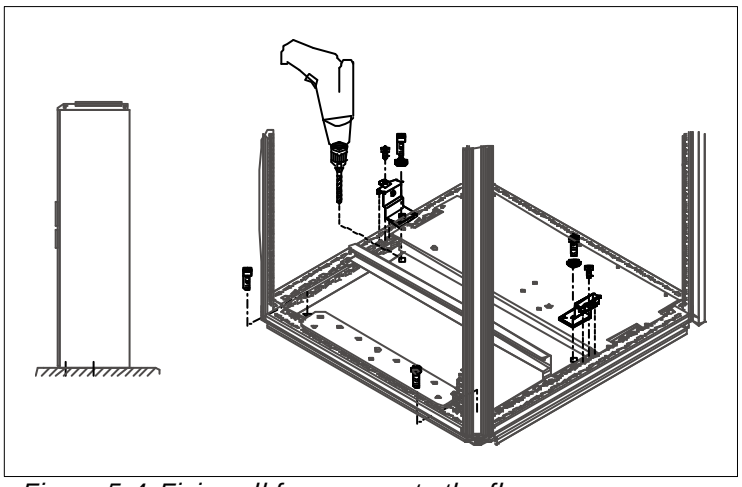

Figure 5-4. Fixing all for corners to the floor

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5.4 AC choke connections

Note: The NXC regenerative low-harmonic drive incorporates an LCL filter instead of AC chokes and this instruction can be ignored.

The AC input choke carries out several functions in the Vacon NX 6- and 12-pulse frequency converter. The input choke is needed as an essential component for motor control, to protect the input and DC-link components against abrupt changes of current and voltage as well as to function as a protection against harmonics.
The NXC 6- and 12-pulse frequency converter is equipped with one or more input AC chokes. The chokes have two inductance levels to optimise the functionality at different supply voltages. In the installation phase, the wiring of the chokes should be checked and changed if needed (not for FR9). The input is always connected to terminal #1 (see picture below) and should not be changed. The output of the choke should be connected to terminal #2 or #3 (see picture below) according to the table below. The terminals are marked with inductance values and applicable voltage.
In units FR10 to FR12, the connection is changed by moving the cable to the appropriate terminals.
In FR13/14, the bridges of the busbar connection should be moved according to the settings shown in the table.

	In units with two or more parallel chokes (some FR11 as well as all FR12 and FR13) all chokes have to be wired in the same way. If chokes are wired differently the converter may be damaged.

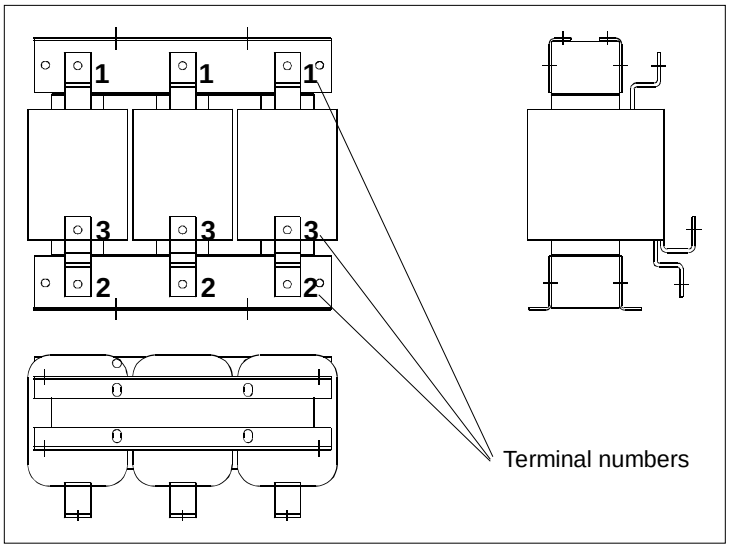

Figure 5-5. Input chokes

Supply voltage	Converter connection (terminals)
400-480Vac/50-60Hz (500V unit)	2
500Vac/50Hz (500V unit)	3
500Vac/50Hz (690V unit)	3
575-690Vac/50-60Hz (690V unit)	3

Figure 5-6. Input chokes tapping in FR13/14 units

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5.5 Auxiliary voltage transformer tappings

Note: An auxiliary voltage transformer is always included as standard in NXC regenerative low-harmonic drives.

If the drive is ordered with an auxiliary voltage transformer for 230V auxiliary voltage supply (+ATx option) the tappings of the transformer have to be set according to the mains voltage.

The tappings of the transformer in 500V drives is by default set to 400V and in 690V drives to 690V unless otherwise ordered.

Locate the transformer in the lower part of the cabinet. The primary side of the transformer has tappings that correspond to standard main voltages. Change to tapping to correspond to the mains voltage in use.

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5.6 Cooling

5.6.1 Free space around the cabinet

Enough space must be left above and in front of the cabinet to ensure sufficient cooling and space for maintenance.
The amount of cooling air required is indicated in the table below. Also make sure that the temperature of the cooling air does not exceed the maximum ambient temperature of the converter.

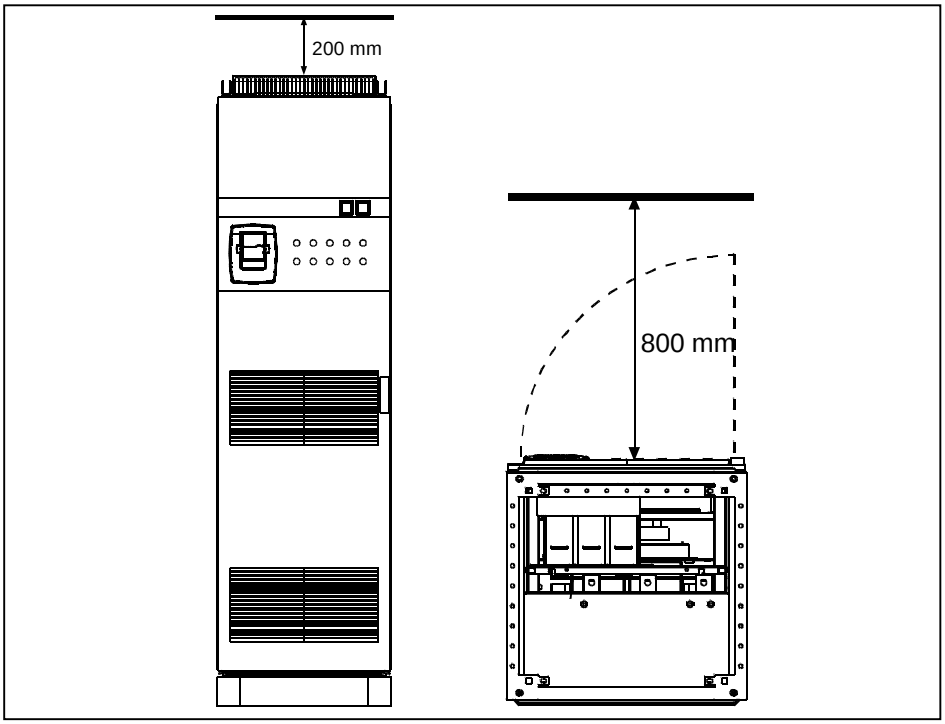

Figure 5-7. Space to be left free above (left) and in front of (right) the cabinet

Type	Cooling air required [m^3/h)
0261—0300 5 0125—0208 6	1000
0385—0520 5 0261—0416 6	2000
0650—0730 5 0460—0590 6	3000
0820—1030 5 0650—0820 6	4000
1300—1450 5 (6-p) 1300—1450 6 (12-p)	6000 7000
1150 5 0920—1180 6	5000
1500 6 (6-p)	9000
1770—2150 5 1900—2250 6	10000

Table 5-4. Required cooling air for NXC 6- and 12-pulse drives

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Type	Cooling air required [m^3/h)
0261—0520 5 0125—0416 6	3100
0590—1030 5 0460—0820 6	6200
1150—1450 5 0920—1180 6	7700
1770—2700 5 1500—2250 6	15400

Table 5-5. Required cooling air for NXC regenerative low-harmonic drives

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5.7 Power losses

The power loss of the frequency converter varies greatly with load and output frequency as well as with the switching frequency used. For dimensioning of cooling or ventilation equipment for electrical rooms the following generic formula gives a good approximation of the heat losses at nominal conditions:

$$P_{loss}\ [kw] = P_{mot}\ [kW] \times 0{,}025$$

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6. CABLING AND CONNECTIONS

6.1 Understanding the power unit topology

Figure 6-1 and Figure 6-2 show the principles for mains and motor connections of the basic 6-pulse drive in frame sizes FR10 to FR14.

Some units built in frame size FR11 have double input devices and require an **even number of supply cables** but an uneven number of **motor cables** can be used.

Units built in frame size FR12 consist of two power modules and require an **even number of supply and motor cables**. See Figure 6-1 and the tables in chapter 6.2.6 .

The 12-pulse drives always have a double set of inputs. The motor connection is size dependent as described above and in Figure 6-1.

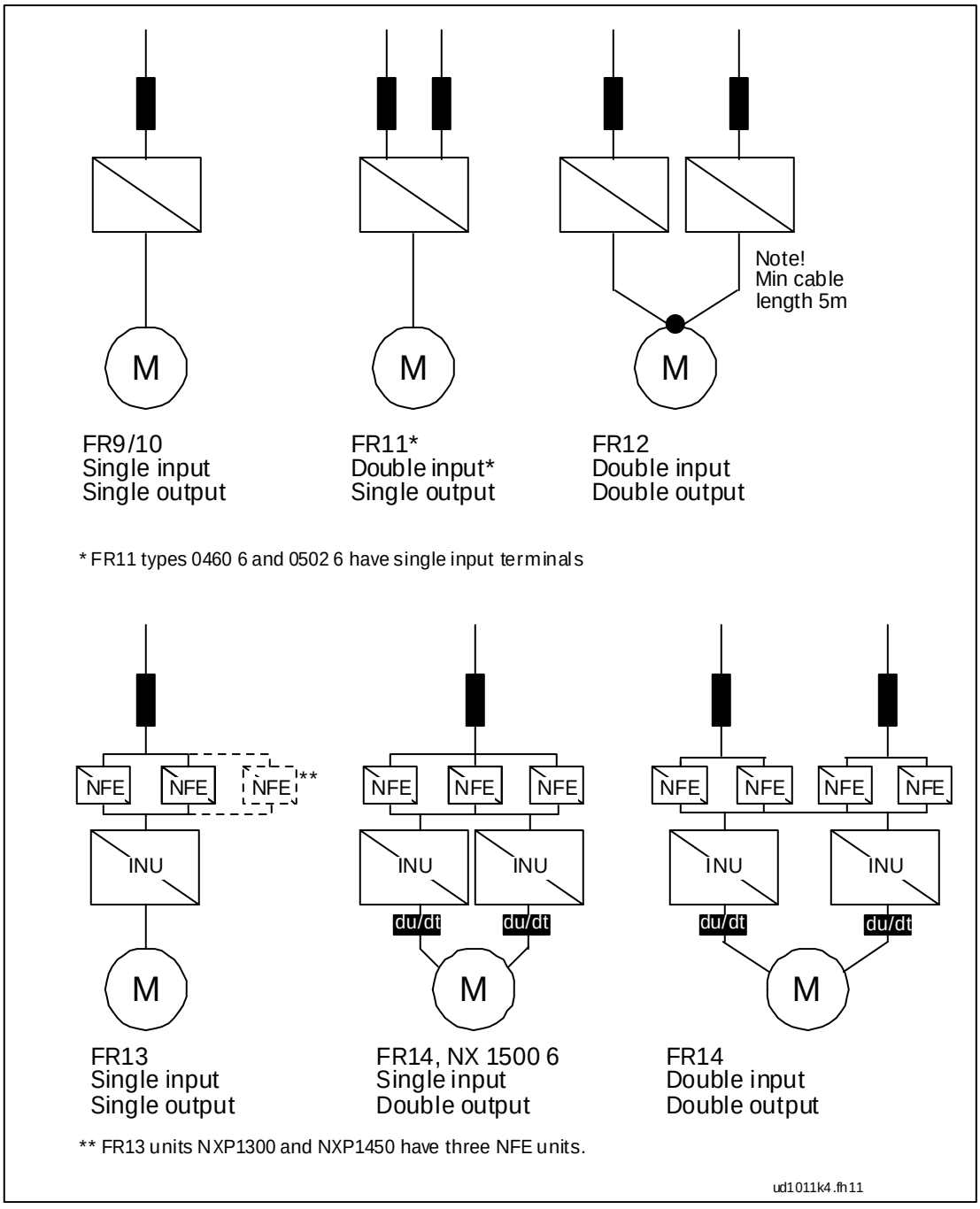

Figure 6-1. Topology of mechanical sizes FR9 – FR14, 6/12-pulse supply

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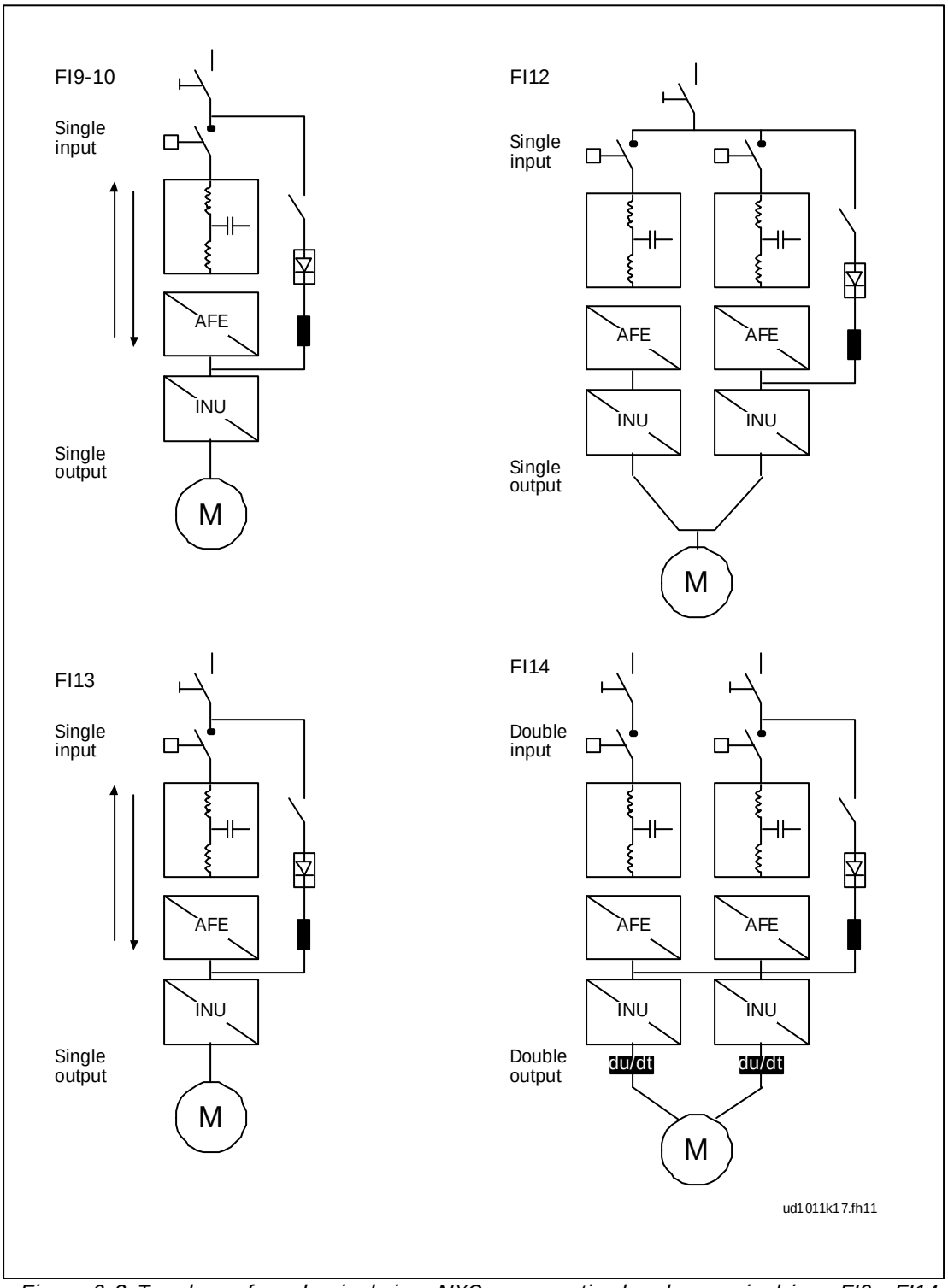

Figure 6-2. Topology of mechanical sizes NXC regenerative low-harmonic drives FI9 – FI14

Note! Some options affect the wiring direction and principle for power cables; always check delivery specific documentation for exact information.

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6.2 Power connections

6.2.1 LCL filter wiring diagram of NXC regenerative low-harmonic drive

The LCL filter in the NXC regenerative low-harmonic drive contains a choke on the mains side, capacitors and a choke on the AFE side. The LCL filter also includes capacitors connected against ground potential. There are resistors connected across the capacitors for discharging these when the LCL filter is disconnected from the input power.

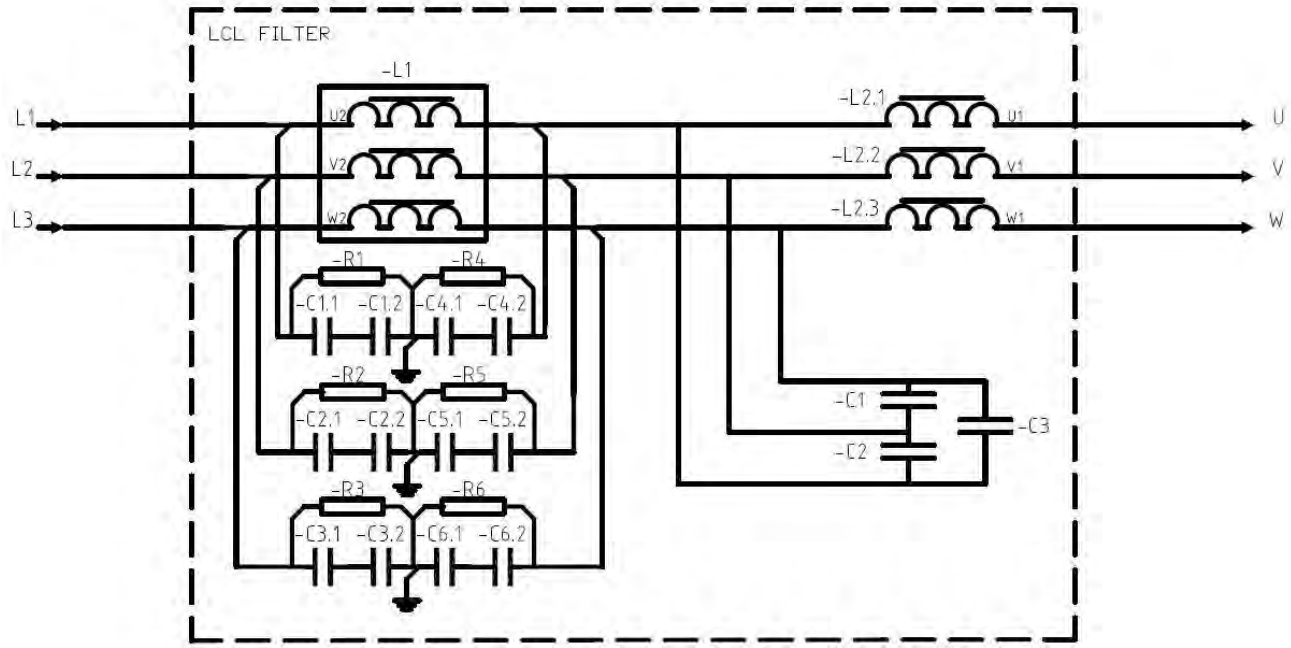

Figure 6-3. Vacon LCL filter wiring diagram.

6.2.1.1 Removing HF capacitors

If a mains rectifier of another manufacturer is connected to the same input transformer, the capacitors must be removed. Otherwise the capacitors must not be removed.

Figure 6-4 (Fi9, Fi10 and Fi12) and Figure 6-5 (Fi13 and Fi14) have a red marking on the lead that has to be removed from each capacitor if the interference suppression capacitors are not to be used. Removing the lead disconnects the capacitors from ground potential.

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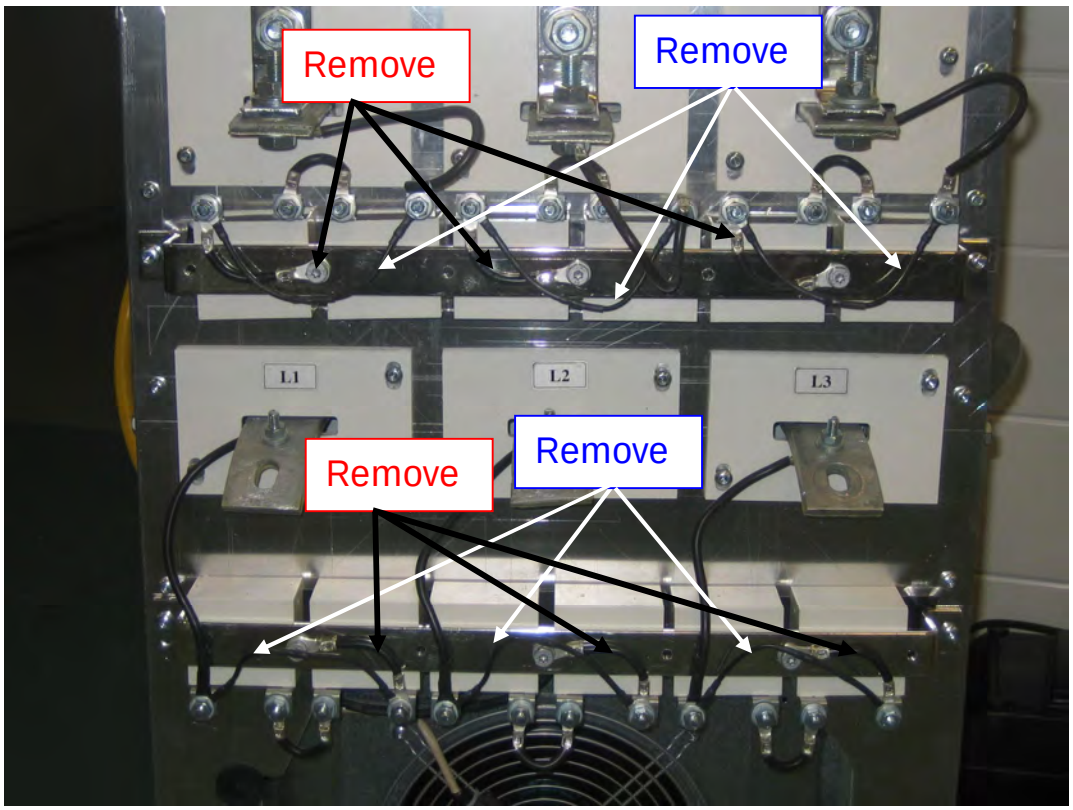

Figure 6-4. HF capacitors in NXC regenerative low-harmonic drive mechanical sizes Fi9,Fi10 and Fi12 LCL filter.

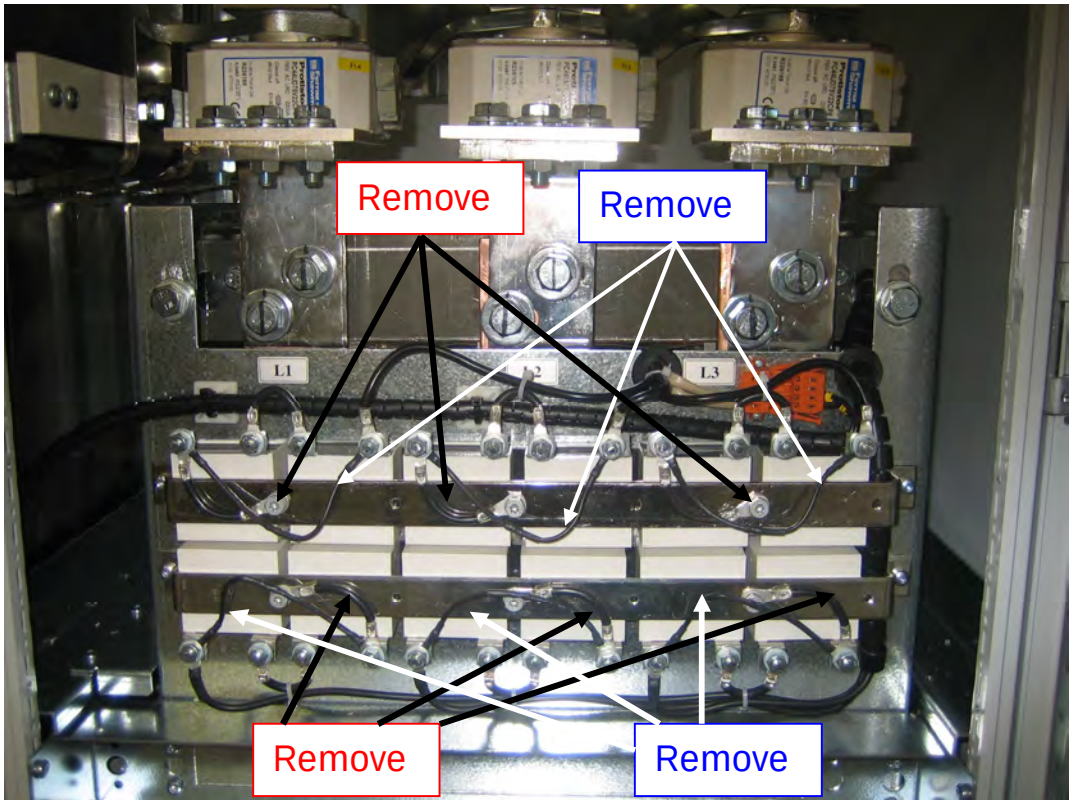

Figure 6-5. HF capacitors in NXC regenerative low-harmonic drive mechanical sizes Fi13-Fi14 LCL filter.

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6.2.2 Mains and motor cables

The mains cables are connected to terminals **L1**, **L2** and **L3** (12-pulse units **1L1, 1L2, 1L3, 2L1, 2L2, 2L3**) and the motor cables to terminals marked with **U**, **V** and **W**, see Figure 6-7.

In converters consisting of double input sections, an even number of input cables is required. In converters consisting of double power modules an even number of motor cables is needed. See tables 6-2 to 6-6 for cabling recommendations.

	In 12-pulse drives with double inputs or outputs it is very important that the same cable dimensions, type and routing is used for all cables. In case the cabling between the converter modules is not symmetrical, unequal load might occur and reduce loadability or even damage the converter.

	In units with double motor outputs the motor cables must not be connected together in the converter end. Always connect the parallel motor cables together in the motor end only. The minimum motor cable length is 5m.

	If a safe switch between the frequency converter and the motor is used, make sure that it is switched on before setting the frequency converter in run state.

The output cables to the motor must be 360° EMC earthed. Separate EMC grounding clamps are supplied with NXC FR9 if an output filter is used and with all drives of sizes FR/Fi10-12. In NXC FR/Fi13-14, EMC grounding is implemented directly through cable glands and grounding clamps are unnecessary. See chapter 6.2.2.1 for more information on EMC grounding for FR/Fi13-14.The EMC grounding clamps can, for instance, be installed on the mounting plate in front of the AC choke as shown in Figure 6-6 below. The EMC grounding clamps must be suited to the output cable diameter to give a 360° contact with the cables. See chapters 6.2.6 and 6.2.7 for output cable diameters. See Figure 6-6.

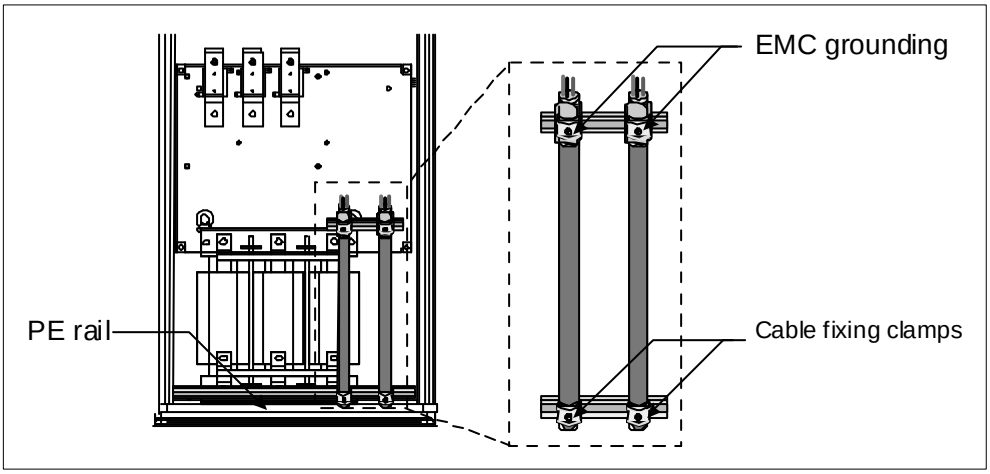

Figure 6-6. Installing EMC grounding

For more detailed cable installation instructions, see chapter 8, step 6.

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Use cables with a temperature rating of at least +70°C. As a rule of thumb, cables and the fuses can be dimensioned according to the frequency converter nominal OUTPUT current which you can find on the rating plate. Dimensioning according to the output current is recommended because the frequency converter input current never significantly exceeds the output current.

Tables 6-2 and show the minimum dimensions of Cu- and Al-cables and the recommended aR fuse sizes.

If the motor temperature protection of the drive (see Vacon All in One Application Manual) is used as an overload protection, the cable should be chosen accordingly. If three or more cables are used parallelly (per block) in bigger units each cable requires a separate overload protection.

Cable type	Level L (2nd environment)	Level T
Mains cable	1	1
Motor cable	2	1/2*
Control cable	4	4

Table 6-1. Cable types required to meet standards

*Recommended

Level L = EN61800-3, 2nd environment

Level T = For IT networks

1 = Power cable intended for fixed installation and the specific mains voltage. Shielded cable not required (DRAKA NK CABLES - MCMK or similar recommended)

2 = Symmetrical power cable equipped with concentric protection wire and intended for the specific mains voltage (DRAKA NK CABLES - MCMK or similar recommended).

4 = Screened cable equipped with compact low-impedance shield (DRAKA NKCABLES - JAMAK, SAB/ÖZCuY-O or similar).

Note: The EMC requirements are fulfilled at factory defaults of switching frequencies (all frames).

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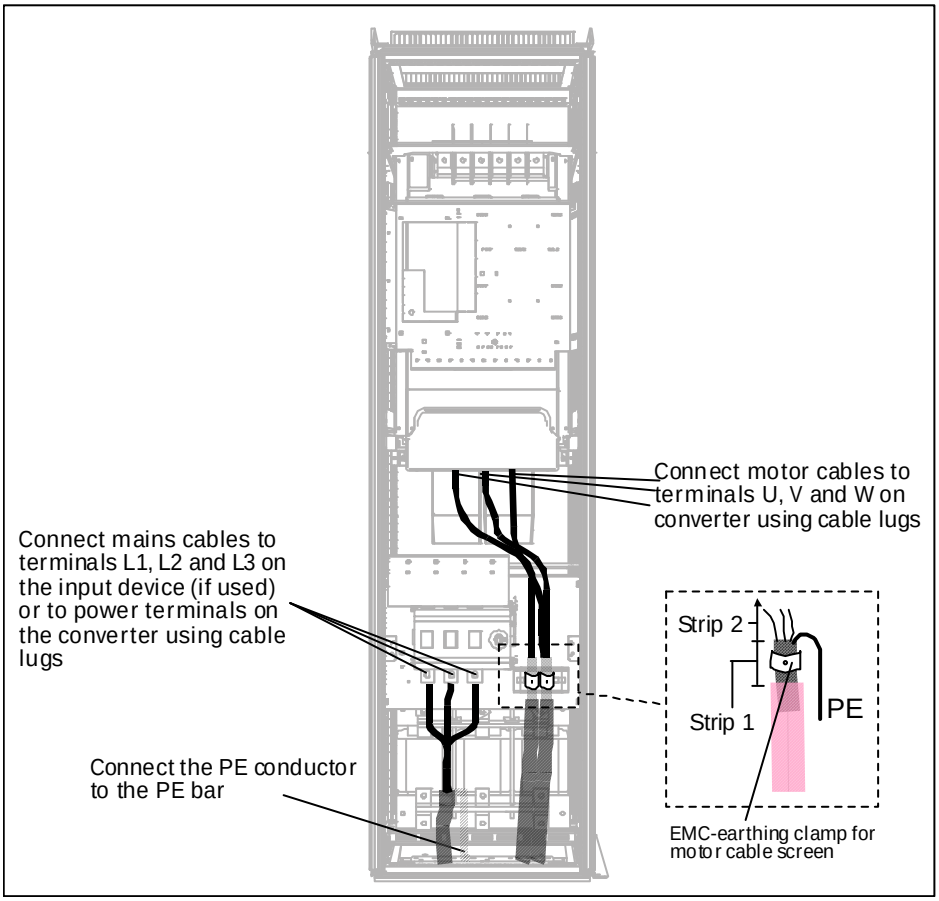
Connect motor cables to terminals U, V and W on converter using cable lugs
Connect mains cables to terminals L1, L2 and L3 on the input device (if used) or to power terminals on the converter using cable lugs
Strip 2
Strip 1
PE
Connect the PE conductor to the PE bar
EMC-earthing clamp for motor cable screen

Figure 6-7. Routing of power cables, 6- and 12-pulse drives, bottom cabling, frames FR10-FR12 (FR10 +ILS as example).

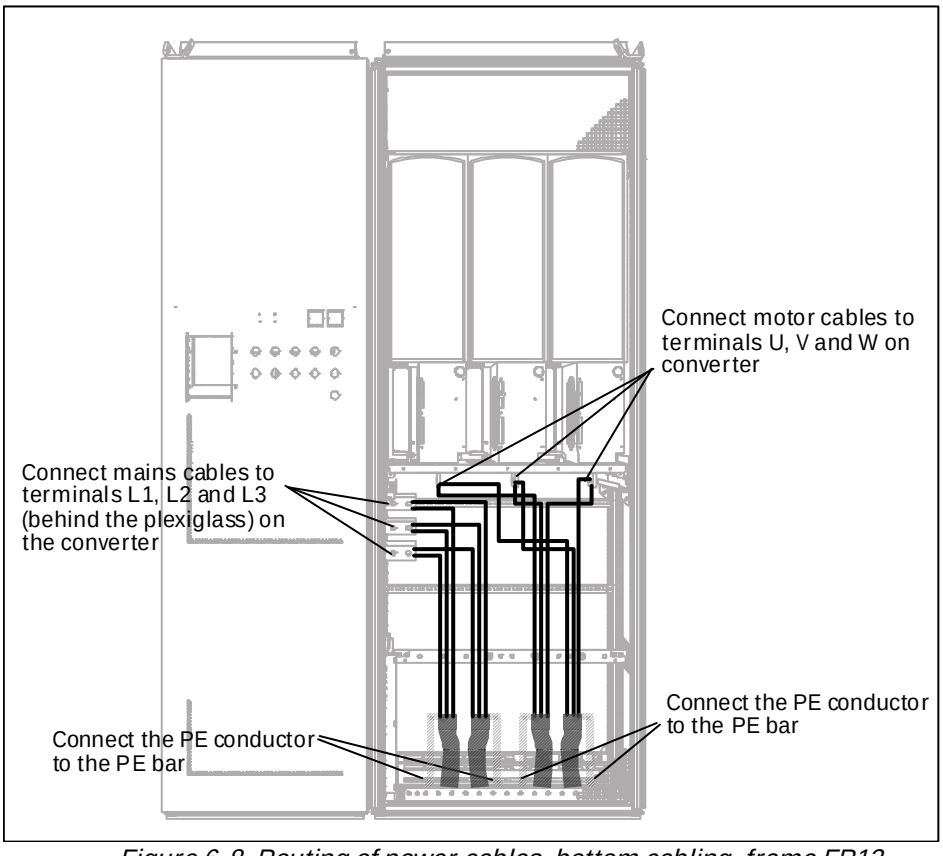
Connect motor cables to terminals U, V and W on converter
Connect mains cables to terminals L1, L2 and L3 (behind the plexiglass) on the converter
Connect the PE conductor to the PE bar
Connect the PE conductor to the PE bar

Figure 6-8. Routing of power cables, bottom cabling, frame FR13

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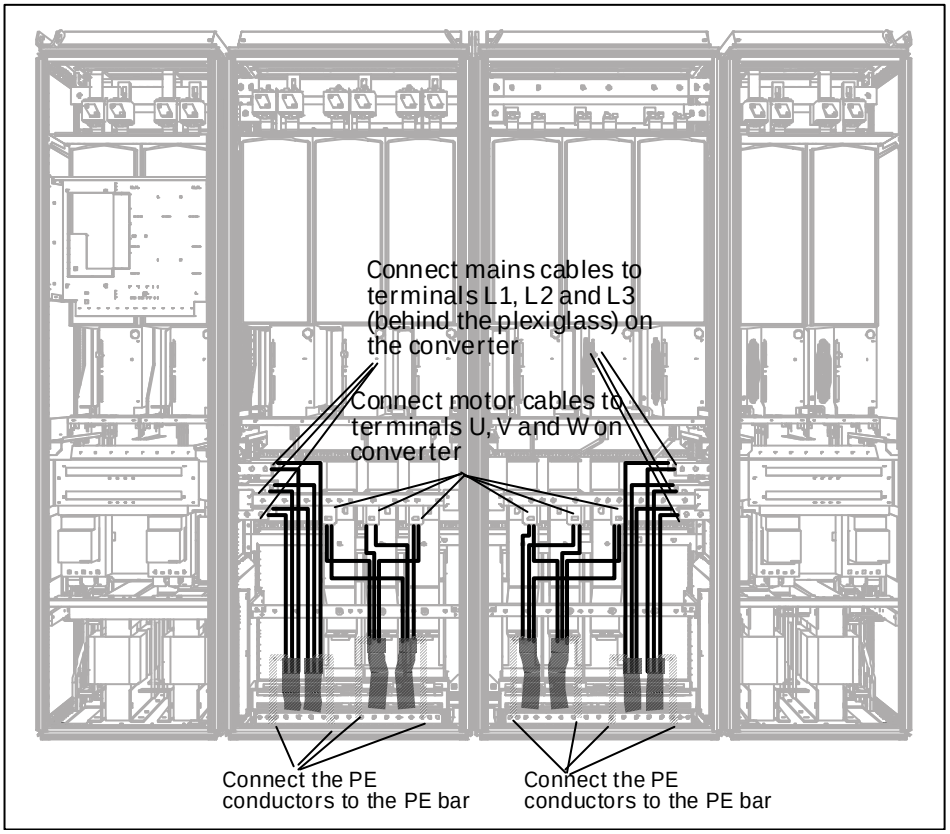
Connect mains cables to terminals L1, L2 and L3 (behind the plexiglass) on the converter
Connect motor cables to terminals U, V and W on converter
Connect the PE conductors to the PE bar
Connect the PE conductors to the PE bar

Figure 6-9. Routing of power cables, bottom cabling, frame FR14

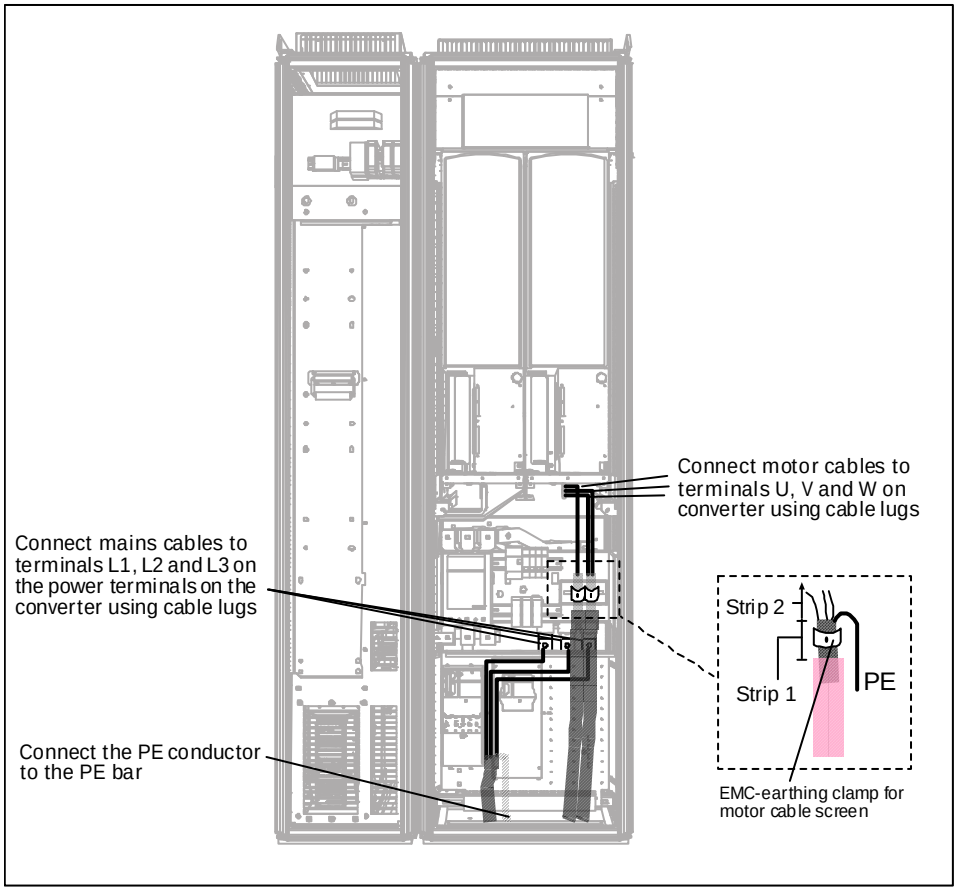
Connect motor cables to terminals U, V and W on converter using cable lugs
Connect mains cables to terminals L1, L2 and L3 on the power terminals on the converter using cable lugs
Strip 2
Strip 1
PE
Connect the PE conductor to the PE bar
EMC-earthing clamp for motor cable screen

Figure 6-10. Routing of power cables, bottom cabling, frame Fi10

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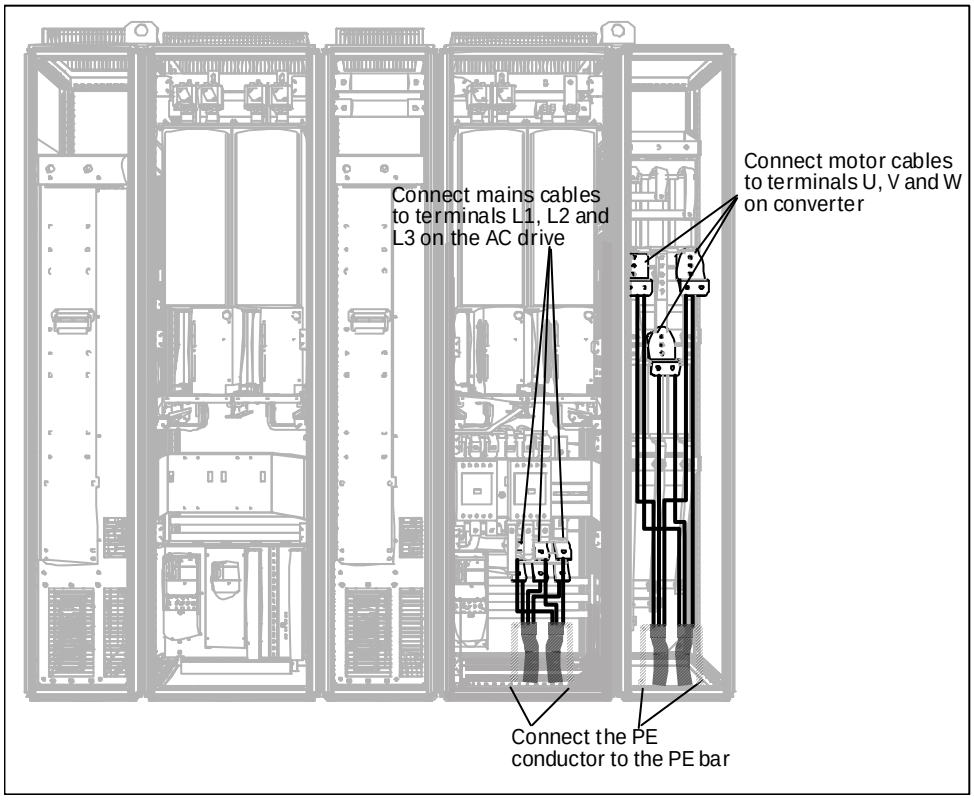
Connect motor cables to terminals U, V and W on converter
Connect mains cables to terminals L1, L2 and L3 on the AC drive
Connect the PE conductor to the PE bar

Figure 6-11. Routing of power cables, bottom cabling, frame Fi12 +ODU (optional)

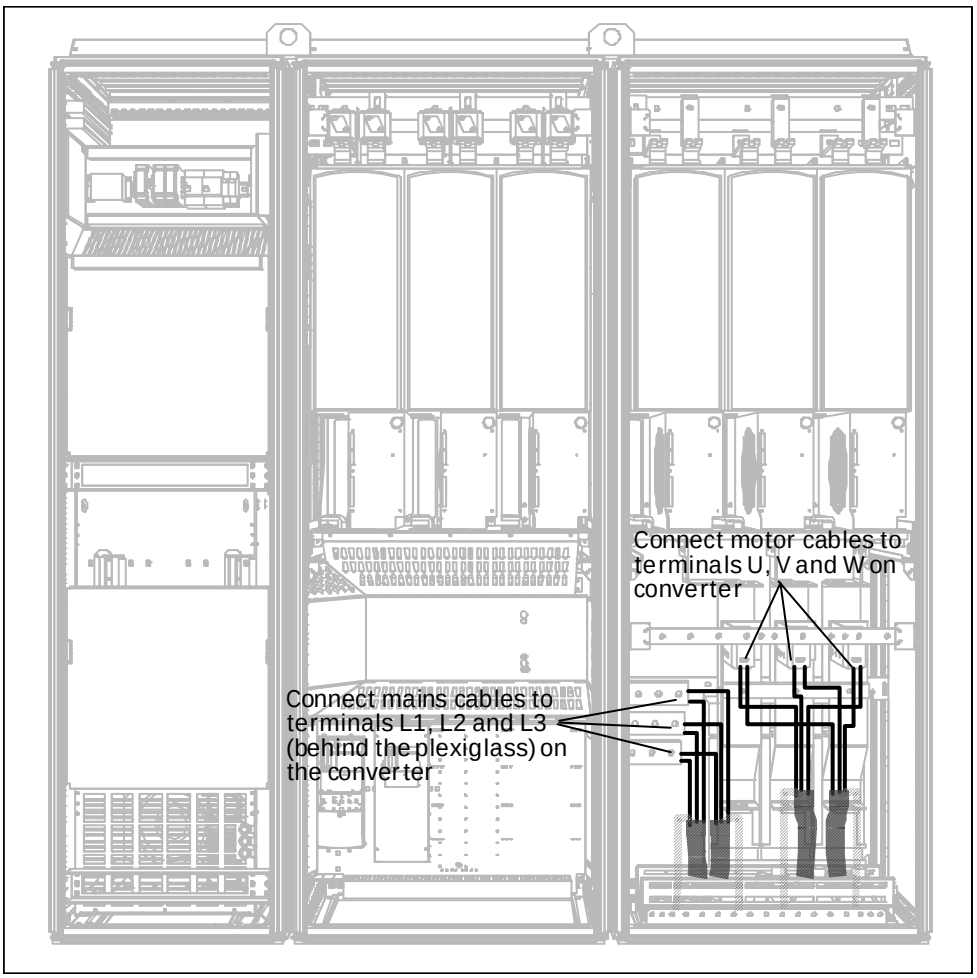
Connect motor cables to terminals U, V and W on converter
Connect mains cables to terminals L1, L2 and L3 (behind the plexiglass) on the converter

Figure 6-12. Routing of power cables, bottom cabling, frame Fi13

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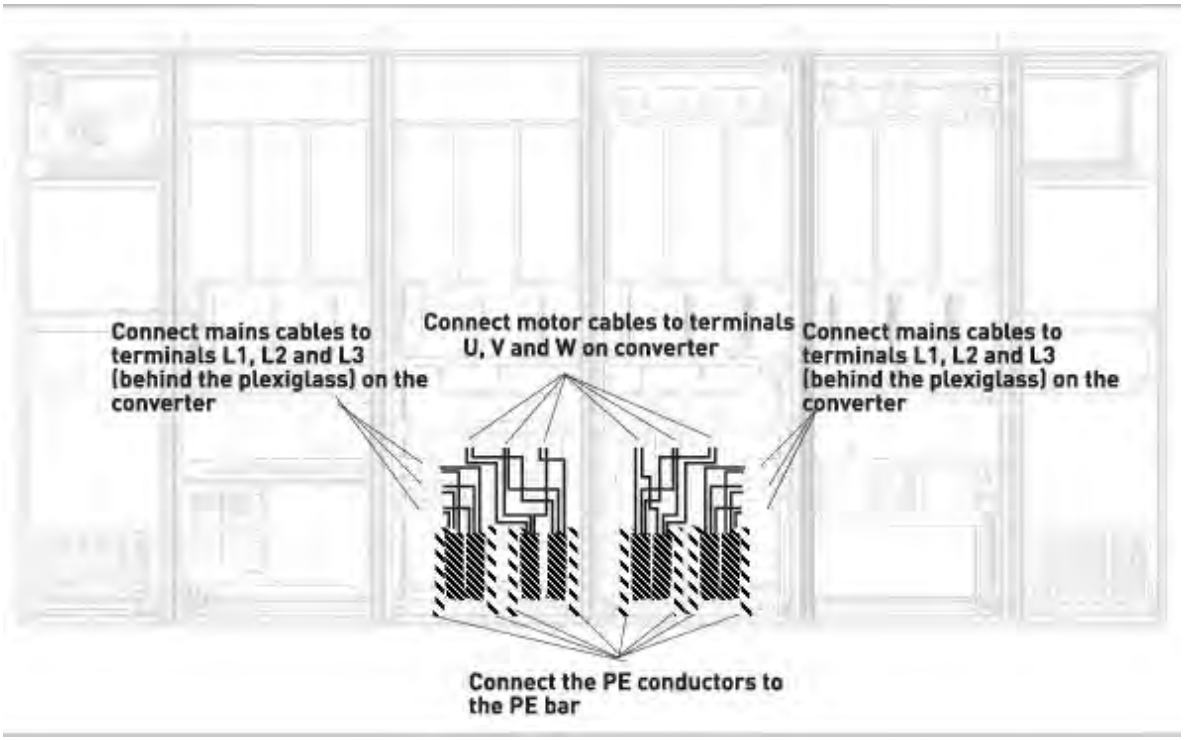
Connect mains cables to terminals L1, L2 and L3 (behind the plexiglass) on the converter
Connect motor cables to terminals U, V and W on converter
Connect mains cables to terminals L1, L2 and L3 (behind the plexiglass) on the converter
Connect the PE conductors to the PE bar

Figure 6-13. Routing of power cables, bottom cabling, frame Fi14

6.2.2.1 Routing of power cables through bottom of cabinet

Route the supply and motor cables through the cabinet bottom as shown in Figure 6-14. To conform to the EMC requirements, a particular cable gland shall be used. The cable glands are designed to be used together with screened cables when electromagnetic compatibility (EMC) is required.

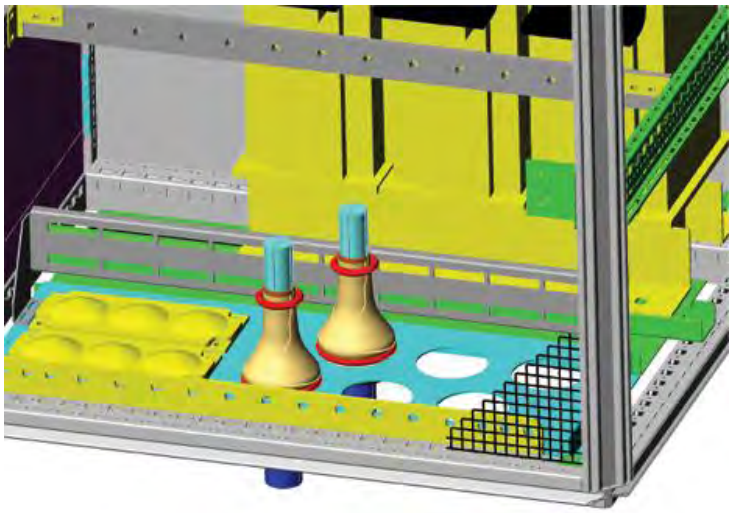

Figure 6-14. Routing of supply and power cables

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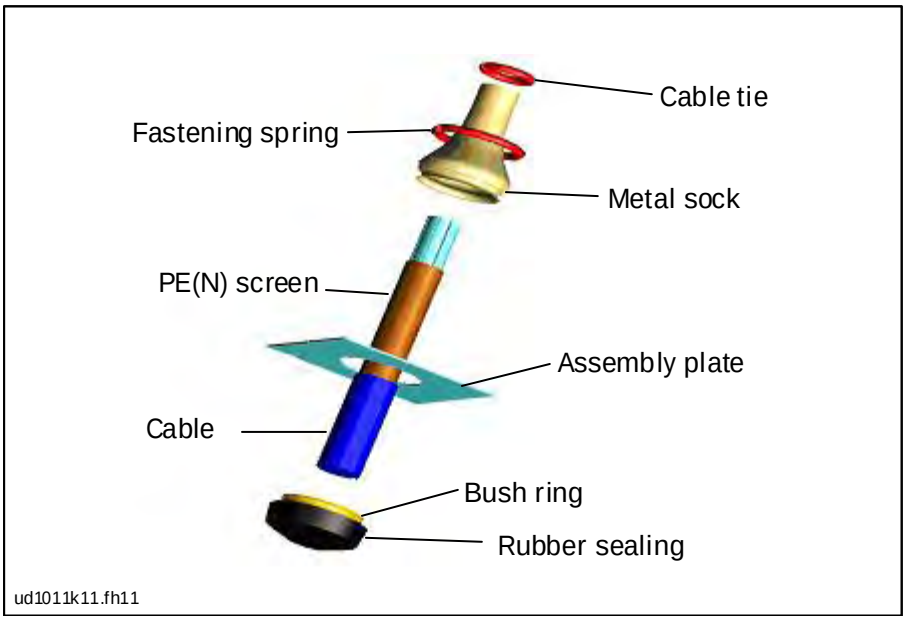
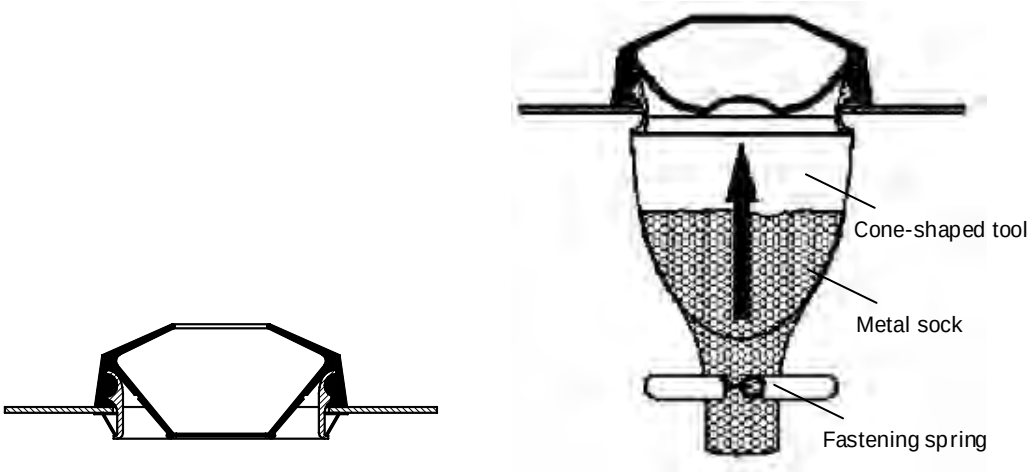


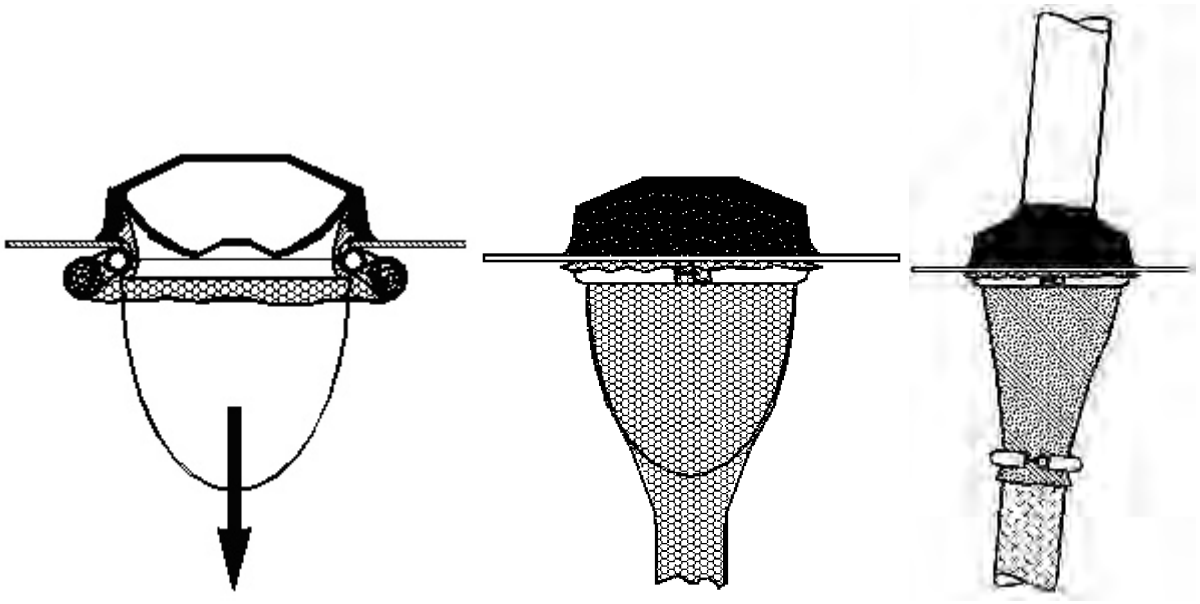
Figure 6-15. Components of the cable gland set

Installing the cable gland

Unless the cable gland is already installed by the manufacturer, follow the procedure below to do this:

1. Assemble the rubber sealing in the narrow groove of the bush ring. Make sure that the gap between the assembly plate and the sealing is tight.
2. Since the fastening spring is rather stiff, we recommend to use a cone-shaped tool to fit the metal sock in the bush ring and then to clamp it with the spring bent into a ring shape. Draw the sock over the groove far enough to be easily fastened with the spring. Make sure that the spring clamps the sock at 360°.
3. Roll up the sock as far as the fastening ring and remove the cone-shaped tool if used. Now the cable installation is easier and the cable will not damage the sock.
4. Clamp the sock to the shielding of cable with a cable tie.





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6.2.2.2 Installation of ferrite rings (+OCM) on the motor cable

Modern PWM Frequency converters based on IGBT transistors generate output pulses having short rise times (0,1...0,2 µs). Those pulse edges increase the stress for motor insulation and also generate high frequency common mode voltages on the motor output. Common mode voltage increases emitted radio interferences and might cause danger of bearing currents when larger motor frames (> 100kW) are used.

Motor cable selection and installation has to be done according to the requirements of the installation environment. The screen of the motor cable has to be connected to earth at every end (frequency converter, safety switch, motor etc.) so that high frequency impedance is as low as possible. The best solution is a 360-degree grounding. If this is difficult to do then connect the PE conductor to ground or panel wall (metallic) right after the stripping point of jacket of cable (see Figure 6-16, alternatives a and b). Influence of common mode voltages can easily be additionally attenuated by installing a common mode choke on the motor output. The simplest way is to use ferrite rings with a diameter large enough to allow the motor phase conductors to be slipped through.

Installation of the ferrite rings:
Slip only the phase conductors through the rings; leave the cable screen below and outside the rings, see Figure 6-16. Separate the PE conductor. In case of parallel motor cables, reserve an equal amount of ferrite ring sets for each cable and feed all the phase conductors of one cable through one set of rings.

Vacon's delivery consists of fixed sets of ferrite rings (option). When ferrite rings are used to attenuate the risk of bearing damages, use always two ferrite ring sets per motor cable.

Note! The ferrite rings are only additional protection. The basic protection against bearing currents is an insulated bearing.

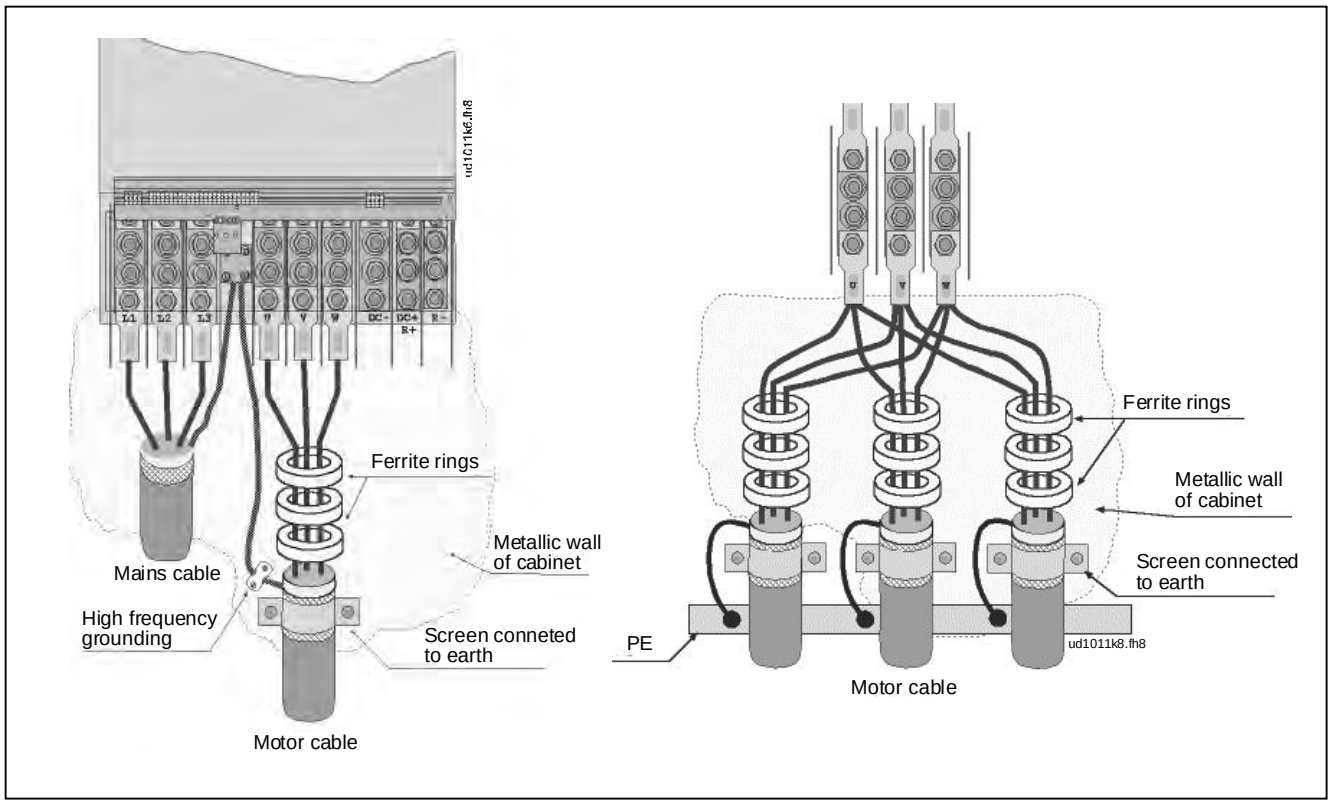

Figure 6-16. Installation of ferrite rings on single (left) and parallel (right) motor cables

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6.2.3 Thermal supervision of option +ODU

Option +ODU can also be equipped with a thermal supervision which will indicate if the filter temperature has exceeded safe limits. Always refer to cabinet specific electrical drawings for details.This NC contact is wired to the external fault input DIN3 by factory default.

NOTE! If the external fault input DIN3 is used for other purposes, make sure that the +ODU fan supervision wiring is changed accordingly. It is also possible to connect the NC contact in series with RUN or RUN ENABLE commands (see relevant application manual for more details).

6.2.4 DC supply and brake resistor cables

Vacon 6- and 12-pulse frequency converters can optionally be equipped with terminals for DC supply and with an external brake resistor. These terminals are marked with **B-**, **B+/R+** and **R-**. The DC bus connection is made to terminals B– and B+ and the brake resistor connection to R+ and R– on the converter module. The converter module terminals can also optionally be wired to customer terminals in the cabinet.

Make sure that the converter is equipped with a brake chopper before connecting a brake resistor.

Do not connect the brake resistor between the terminals B- and B+ as this will damage the drive.

6.2.5 Control cable

For information on control cables see chapter 8.2. The control cables are routed down to the bottom of the cabinet in the left inner side of the cabinet.

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6.2.6 Cable and fuse sizes, 380-500V units

The table below shows typical cable sizes and types that can be used with the converter. The final selection should be made according to local regulations, cable installation conditions and cable specification.

6.2.6.1 6-pulse drives

Frame	Type	I_L [A]	Bussmann/Ferraz Shawmut fuse type	Fuse I_n [A]	Mains and motor cable[1] [mm²]	No. of supply cables	No. of motor cables
FR9	NX0261 5	261	170M5813 (3 pcs) NH2UD69V500PV (3 pcs)	700/500	Cu: 3*185+95 or 2*(3*120+70)	Even/Odd	Even/Odd
	NX0300 5	300	170M5813 (3 pcs) NH2UD69V500PV (3 pcs)	700/500	Cu: 2*(3*120+70)	Even/Odd	Even/Odd
FR10	NX0385 5	385	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NX0460 5	460	170M8547 (3 pcs) NH3UD69V1000PV (3 pcs)	1250/ 1000	Cu: 2*(3*150+70) Al: 2*(3*240Al+72Cu)	Even/Odd	Even/Odd
	NX0520 5	520	170M8547 (3 pcs) NH3UD69V1000PV (3 pcs)	1250/ 1000	Cu: 2*(3*185+95) Al: 2*(3*300Al+88Cu)	Even/Odd	Even/Odd
FR11	NX0590 5	590	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 2*(3*240+120) Al: 4*(3*120Al+41Cu)	Even	Even/Odd
	NX0650 5	650	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*95+50) Al: 4*(3*150Al+41Cu)	Even	Even/Odd
	NX0730 5	730	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*120+70) Al: 4*(3*185Al+57Cu)	Even	Even/Odd
FR12	NX0820 5	820	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/ 1000	Cu: 4*(3*150+70) Al: 4*(3*185Al+57Cu)	Even	Even
	NX0920 5	920	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/ 1000	Cu: 4*(3*150+70) Al: 4*(3*240Al+72Cu)	Even	Even
	NX1030 5	1030	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/ 1000	Cu: 4*(3*185+95) Al: 4*(3*300Al+88Cu)	Even	Even
FR13	NX1150 5	1150	No additional drive fuses needed		Cu:5*(3*150+70) Al:6*(3*185+57Cu)	Even/Odd	Even/Odd
	NX1300 5	1300	No additional drive fuses needed		Cu:5*(3*185+95) Al:6*(3*240+72Cu)	Even/Odd	Even/Odd
	NX1450 5	1450	No additional drive fuses needed		Cu:6*(3*185+95) Al:6*(3*240+72Cu)	Even/Odd	Even/Odd
FR14	NX1770 5	1770	No additional drive fuses needed		Cu: 6*(3*240+120) Al: 8*(3*240+72Cu)	Even	Even
	NX2150 5	2150	No additional drive fuses needed		Cu: 8*(3*185+95) Al: 8*(3*300+88Cu)	Even	Even

Table 6-2. Cable and fuse sizes for Vacon NX_5, 6-pulse supply

[1]Based on correction factor 0.7. Cables are laid on a cable ladder side by side, three ladders on top of each other. Ambient temperature is 30°C (86°F). EN60204-1 and IEC 60364-5-523.

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6.2.6.2 12-pulse drives

Frame	Type	I_L [A]	Bussmann / Ferraz Shawmut fuse type	Fuse I_n [A]	Mains and motor cable[1] [mm²]	No. of supply cables	No. of motor cables
FR10	NX0385 5	385	170M5813 (3 pcs) NH2UD69V500PV (3 pcs)	700/500	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NX0460 5	460	170M5813 (3 pcs) NH2UD69V500PV (3 pcs)	700/500	Cu: 2*(3*150+70) Al: 2*(3*240Al+72Cu)	Even/Odd	Even/Odd
	NX0520 5	520	170M5813 (3 pcs) NH2UD69V500PV (3 pcs)	700/500	Cu: 2*(3*185+95) Al: 2*(3*300Al+88Cu)	Even/Odd	Even/Odd
FR11	NX0590 5	590	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 2*(3*240+120) Al: 4*(3*120Al+41Cu)	Even	Even/Odd
	NX0650 5	650	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*95+50) Al: 4*(3*150Al+41Cu)	Even	Even/Odd
	NX0730 5	730	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*120+70) Al: 4*(3*185Al+57Cu)	Even	Even/Odd
FR12	NX0820 5	820	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/1000	Cu: 4*(3*150+70) Al: 4*(3*185Al+57Cu)	Even	Even
	NX0920 5	920	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/1000	Cu: 4*(3*150+70) Al: 4*(3*240Al+72Cu)	Even	Even
	NX1030 5	1030	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/1000	Cu: 4*(3*185+95) Al: 4*(3*300Al+88Cu)	Even	Even
FR13	NX1150 5	1150	No additional drive fuses needed		Cu: 4(3*240+170) Al: 6*(3*185Al+57Cu)	Even	Even/Odd
	NX1300 5	1300	No additional drive fuses needed		Cu: 6(3*150+70) Al: 6*(3*240Al+72Cu)	Even	Even/Odd
	NX1450 5	1450	No additional drive fuses needed		Cu: 6(3*185+95) Al: 6*(3*240Al+72Cu)	Even	Even/Odd
FR14	NX1770 5	1770	No additional drive fuses needed		Cu: 6*(3*240+120) Al: 8*(3*240Al+72Cu)	Even	Even
	NX2150 5	2150	No additional drive fuses needed		Cu: 8*(3*185+95) Al: 8*(3*300Al+88Cu)	Even	Even

Table 6-3. Cable and fuse sizes for Vacon NX_5, 12-pulse supply

[1] Based on correction factor 0.7. Cables are laid on a cable ladder side by side, three ladders on top of each other. Ambient temperature is 30°C (86°F). EN60204-1 and IEC 60364-5-523.

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6.2.6.3 Regenerative low-harmonic drives

Frame	Type	I_L [A]	Bussmann/Ferraz Shawmut fuse type	Fuse I_n [A]	Mains and motor cable[1] [mm²]	No. of supply cables	No. of motor cables
Fi9	NX0261 5	261	170M6202 (3 pcs) NH2UD69V500PV (3 pcs)	700/500	Cu: 3*185+95 or 2*(3*120+70)	Even/Odd	Even/Odd
	NX0300 5	300	170M5813 (3 pcs) NH2UD69V500PV (3 pcs)	700/500	Cu: 2*(3*120+70)	Even/Odd	Even/Odd
Fi10	NX0385 5	385	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NX0460 5	460	170M8547 (3 pcs) NH3UD69V1000PV (3 pcs)	1250/ 1000	Cu: 2*(3*150+70) Al: 2*(3*240Al+72Cu)	Even/Odd	Even/Odd
	NX0520 5	520	170M8547 (3 pcs) NH3UD69V1000PV (3 pcs)	1250/ 1000	Cu: 2*(3*185+95) Al: 2*(3*300Al+88Cu)	Even/Odd	Even/Odd
Fi12	NX0820 5	820	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/ 1000	Cu: 4*(3*150+70) Al: 4*(3*185Al+57Cu)	Even	Even
	NX0920 5	920	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/ 1000	Cu: 4*(3*150+70) Al: 4*(3*240Al+72Cu)	Even	Even
	NX1030 5	1030	170M8547 (6 pcs) NH3UD69V1000PV (6 pcs)	1250/ 1000	Cu: 4*(3*185+95) Al: 4*(3*300Al+88Cu)	Even	Even
Fi13	NX1150 5	1150	No additional drive fuses needed		Cu:5*(3*150+70) Al:6*(3*185+57Cu)	Even/Odd	Even/Odd
	NX1300 5	1300	No additional drive fuses needed		Cu:5*(3*185+95) Al:6*(3*240+72Cu)	Even/Odd	Even/Odd
	NX1450 5	1450	No additional drive fuses needed		Cu:6*(3*185+95) Al:6*(3*240+72Cu)	Even/Odd	Even/Odd
Fi14	NX1770 5	1770	No additional drive fuses needed		Cu: 6*(3*240+120) Al: 8*(3*240+72Cu)	Even	Even
	NX2150 5	2150	No additional drive fuses needed		Cu: 8*(3*185+95) Al: 8*(3*300+88Cu)	Even	Even
	NX2700 5	2700	No additional drive fuses needed		Cu: 8*(3*185+95) Al: 8*(3*300+88Cu)	Even	Even

Table 6-4. Cable and aR fuse sizes for Vacon NX_5 Regenerative low-harmonic drive.

[1] Based on correction factor 0.7. Cables are laid on a cable ladder side by side, three ladders on top of each other. Ambient temperature is 30°C (86°F). EN60204-1 and IEC 60364-5-523.

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6.2.7 Cable and fuse sizes, 500/525-690V units

The table below shows typical cable sizes and types that can be used with the converter.
The final selection should be done according to local regulations, cable installation conditions and cable specification.

6.2.7.1 6-pulse drives

Frame	Type	I_L [A]	Bussmann/ Ferraz Shawmut fuse type	Fuse I_n [A]	Mains and motor cable[1] [mm²]	No of supply cables	No of motor cables
FR9	NX0125 6 NX0144 6 NX0170 6 NX0208 6	125 144 170	170M3819 (3 pcs) NH1UD69V400PV (3 pcs)	400	Cu: 3*95+50	Even/Odd	Even/Odd
		208	170M3819 (3 pcs) NH1UD69V400PV (3 pcs)	400	Cu: 3*150+70	Even/Odd	Even/Odd
FR10	NX0261 6	261	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 3*185+95 Al: 2*(3*95Al+29Cu)	Even/Odd	Even/Odd
	NX0325 6	325	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 2*(3*95+50) Al: 2*(3*150Al+41Cu)	Even/Odd	Even/Odd
	NX0385 6	385	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NX0416 6	416	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 2*(3*150+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
FR11	NX0460 6	460	170M8547 (3 pcs) NH3UD69V1000PV (3 pcs)	1250	Cu: 2*(3*150+70) Al: 2*(3*240Al+72Cu)	Even/Odd	Even/Odd
	NX0502 6	502	170M8547 (3 pcs) NH3UD69V1000PV (3 pcs)	1250	Cu: 2*(3*185+95) Al: 2*(3*300Al+88 Cu)	Even/Odd	Even/Odd
	NX0590 6	590	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 2*(3*240+120) Al: 4*(3*120Al+41Cu)	Even	Even/Odd
FR12	NX0650 6	650	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*95+50) Al: 4*(3*150Al+41Cu)	Even	Even
	NX0750 6	750	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*120+70) Al: 4*(3*150Al+41Cu)	Even	Even
	NX0820 6	820	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*150+70) Al: 4*(3*185Al+57Cu)	Even	Even
FR13	NX0920 6	920	No additional drive fuses needed		Cu:4*(3*150+70) Al:4*(3*2405+72Cu)	Even/Odd	Even/Odd
	NX1030 6	1030	No additional drive fuses needed		Cu:4*(3*185+95) Al:5*(3*185+57Cu)	Even/Odd	Even/Odd
	NX1180 6	1180	No additional drive fuses needed		Cu:5*(3*185+95) Al:6*(3*185+72Cu)	Even/Odd	Even/Odd
FR14	NX1500 6	1500	No additional drive fuses needed		Cu:6*(3*185+95) Al:8*(3*185+57Cu)	Even/Odd	Even
	NX1900 6	1900	No additional drive fuses needed		Cu:6*(3*240+120) Al:8*(3*240+72Cu)	Even	Even
	NX2250 6	2250	No additional drive fuses needed		Cu:8*(3*240+120) Al:8*(3*300+88Cu)	Even	Even

Table 6-5. Cable and aR fuse sizes for Vacon NX_6, 6-pulse supply

[1] Based on correction factor 0.7. Cables are laid on a cable ladder side by side, three ladders on top of each other. Ambient temperature is 30°C (86°F). EN60204-1 and IEC 60364-5-523.

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6.2.7.2 12-pulse drives

Frame	Type	I_L [A]	Bussmann /Ferraz Shawmut fuse type	Fuse I_n [A]	Mains and motor cable[1] [mm²]	No of supply cables	No of motor cables
FR10	NX0261 6	261	170M5813 (6 pcs) NH2UD69V500PV (6 pcs)	700/500	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NX0325 6	325	170M5813 (6 pcs) NH2UD69V500PV (6 pcs)	700/500	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NX0385 6	385	170M5813 (6 pcs) NH2UD69V500PV (6 pcs)	700/500	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NX0416 6	416	170M5813 (6 pcs) NH2UD69V500PV (6 pcs)	700/500	Cu: 2*(3*150+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
FR11	NX0460 6	460	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 2*(3*150+70) Al: 2*(3*240Al+72Cu)	Even/Odd	Even/Odd
	NX0502 6	502	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 2*(3*185+95) Al: 2*(3*300Al+88 Cu)	Even/Odd	Even/Odd
	NX0590 6	590	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 2*(3*240+120) Al: 4*(3*120Al+41Cu)	Even	Even/Odd
FR12	NX0650 6	650	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*95+50) Al: 4*(3*150Al+41Cu)	Even	Even
	NX0750 6	750	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*120+70) Al: 4*(3*150Al+41Cu)	Even	Even
	NX0820 6	820	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*3*150+70) Al: 4*(3*185Al+57Cu)	Even	Even
FR13	NX0920 6	920	No additional drive fuses needed		Cu:4x(3x150+70) Al:4x(3x2405+72Cu)	Even	Even/Odd
	NX1030 6	1030	No additional drive fuses needed		Cu:4x(3x185+95) Al:6x(3x150+41Cu)	Even	Even/Odd
	NX1180 6	1180	No additional drive fuses needed		Cu:6x(3x185+95) Al:6x(3x185+72Cu)	Even	Even/Odd
FR14	NX1500 6	1500	No additional drive fuses needed		Cu:6*(3*185+95) Al:8*(3*185+57Cu)	Even	Even
	NX1900 6	1900	No additional drive fuses needed		Cu:6*(3*240+120) Al:8*(3*240+72Cu)	Even	Even
	NX2250 6	2250	No additional drive fuses needed		Cu:8*(3*240+120) Al:8*(3*300+88Cu)	Even	Even

Table 6-6. Cable and aR fuse sizes for Vacon NX_6, 12-pulse supply

[1] Based on correction factor 0.7. Cables are laid on a cable ladder side by side, three ladders on top of each other. Ambient temperature is 30°C (86°F). EN60204-1 and IEC 60364-5-523.

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6.2.7.3 Regenerative low-harmonic drives

Frame	Type	I_L [A]	Bussmann / Ferraz Shawmut fuse type	Fuse I_n [A]	Mains and motor cable[1] [mm²]	No of supply cables	No of motor cables
Fi9	NX0125 6 NX0144 6 NX0170 6 NX0208 6	125 144 170	170M3819 (3 pcs) NH1UD69V400PV (3 pcs)	400	Cu: 3*95+50	Even/Odd	Even/Odd
		208	170M3819 (3 pcs) NH1UD69V400PV (3 pcs)	400	Cu: 3*150+70	Even/Odd	Even/Odd
Fi10	NX0261 6	261	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 3*185+95 Al: 2*(3*95Al+29Cu)	Even/Odd	Even/Odd
	NX0325 6	325	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 2*(3*95+50) Al: 2*(3*150Al+41Cu)	Even/Odd	Even/Odd
	NX0385 6	385	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 2*(3*120+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
	NX0416 6	416	170M5813 (3 pcs) NH2UD69V700PV (3 pcs)	700	Cu: 2*(3*150+70) Al: 2*(3*185Al+57Cu)	Even/Odd	Even/Odd
Fi12	NX0650 6	650	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*95+50) Al: 4*(3*150Al+41Cu)	Even	Even
	NX0750 6	750	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*120+70) Al: 4*(3*150Al+41Cu)	Even	Even
	NX0820 6	820	170M5813 (6 pcs) NH2UD69V700PV (6 pcs)	700	Cu: 4*(3*150+70) Al: 4*(3*185Al+57Cu)	Even	Even
Fi13	NX0920 6	920	No additional drive fuses needed		Cu:4*(3*150+70) Al:4*(3*2405+72Cu)	Even/Odd	Even/Odd
	NX1030 6	1030	No additional drive fuses needed		Cu:4*(3*185+95) Al:5*(3*185+57Cu)	Even/Odd	Even/Odd
	NX1180 6	1180	No additional drive fuses needed		Cu:5*(3*185+95) Al:6*(3*185+72Cu)	Even/Odd	Even/Odd
Fi14	NX1500 6	1500	No additional drive fuses needed		Cu:6*(3*185+95) Al:8*(3*185+57Cu)	Even/Odd	Even
	NX1900 6	1900	No additional drive fuses needed		Cu:6*(3*240+120) Al:8*(3*240+72Cu)	Even	Even
	NX2250 6	2250	No additional drive fuses needed		Cu:8*(3*240+120) Al:8*(3*300+88Cu)	Even	Even

6-7. Cable and aR fuse sizes for Vacon NX_6 Regenerative low-harmonic drive.

[1] Based on correction factor 0.7. Cables are laid on a cable ladder side by side, three ladders on top of each other. Ambient temperature is 30°C (86°F). EN60204-1 and IEC 60364-5-523.

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7. LOW HARMONIC REGENERATIVE CABINET DRIVE

This chapter describes the functionalities of control devices (switches, push-buttons and LED lamps) of the NXC low-harmonic regenerative drive (mechanical units FI9-14). The functionalities of additional "+" options are not described here.

7.1 NXC Low-Harmonic Regenerative Cabinet Pre-Charging and MCCB Operating Instructions

There are three different ways to control the DC pre-charging circuit and the circuit-breakers (MCCB) of the low harmonic regenerative drive. The desired control place or the manner of control can be selected with the *REM-MAN-AUTO* selector switch (-S6). The three possible control places/ways are:

- MAN – Manual operation by the *0-1-Start* switch on the cabinet door
- REM – Remote operation with signals to the control terminals
- AUTO – Automatic operation which automatically pre-charges and closes the MCCB when the supply voltage is energized

Figure 7-1. MCCB Control selector switch (-S6)

7.1.1 Manual operation (MAN)

The operator can control the circuit-breaker (MCCB) and the charging circuit manually from the cabinet while the MCCB control switch –S6 is in *Man* position. The *0–1-Start* switch is used for the local operation of the MCCB and pre-charging circuit.

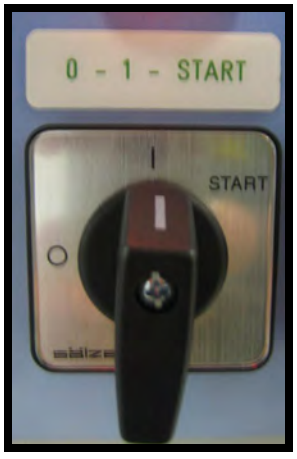

Figure 7-2. 0-1-Start Control switch (-S10)

Turning the switch –S10 into position *0* will open the circuit-breaker if it is closed or stop the possible ongoing pre-charging regardless of the selected control place/manner.

Turning the switch into position *1* enables the pre-charging and the circuit-breaker to be controlled by the selected mode of the *REM-MAN-AUTO* selector switch.

Turning the switch into position *Start* will start the pre-charging of DC busbar. The pre-charging takes about 5-10 s depending on the size of the drive. When DC voltage has reached a certain level the AFE control unit will automatically close the circuit-breaker. The *Start* position of the switch is spring-retuned and the switch will automatically return to position *1* when released. The pre-charging can be aborted by turning the switch to position *0*. In case of a blackout in the supplying network, the under-voltage release coil will open the circuit-breaker. Pre-charging and MCCB closing have to be activated by the operator when the supply is energized.

The *AFE Ready* LED will illuminate when the MCCB is closed and AC power is connected to the AFE unit and there are no active faults. The AFE ready LED works in the same way irrespective of the operation manner/place.

Figure 7-3. AFE Ready indicator

The Run command has to be given to the AFE unit from the keypad, I/O signal or bus communication before the inverter INU can be started (operated).

7.1.2 Remote operation (REM)

It is possible to control the circuit-breaker and the charging circuit from a remote location/system with potential-free contacts while the MCCB control switch –S6 is in *REM* position.

Normally closed (NC) contact has to be connected to terminals X1:60 and X1:61 (terminal name can vary depending on the frame size). This contact has to be in the NC state before the pre-charging can be activated. Opening this contact will open circuit-breakers and stop the ongoing pre-charging.
A remote pulse duration (0.4-1s) connected to terminals X1:57 and X1:58 will start the charging of the drive, and when DC voltage has reached a certain level, the AFE unit will automatically close the circuit-breakers (terminal name can vary depending on the frame size). The Run command has to be given to the AFE unit from the keypad, I/O signal or bus communication before the inverter INU can be started (operated).

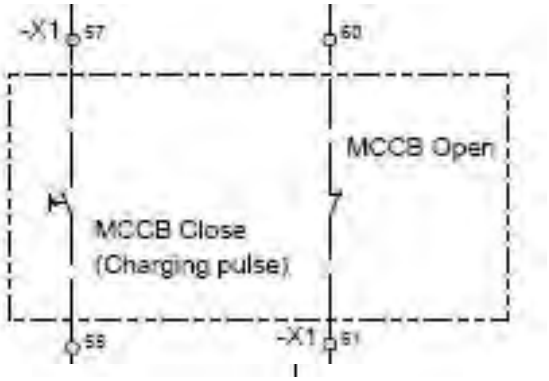

Figure 7-4. Circuit diagram of remote contacts for the control of the MCCB and pre-charging circuit (NXC regenerative low-harmonic FR12)

In case of a voltage drop of $<0.7xU_N$ or a blackout in the supplying network, the undervoltage release coil will open the circuit-breaker and pre-charging and MCCB closing has to be activated by the remote charging pulse when the supply is energized.

7.1.3 Automatic operation (AUTO)

The pre-charging and closing of the circuit-breaker is automatically done when the *REM-MAN-AUTO* selector switch is in *AUTO* position and the supply voltage is energized. The pre-charging of the units will automatically (directly) start when the control switch -S6 is turned into *Auto* position. The AFE unit will automatically close the circuit-breakers after DC voltage has reached a certain level and the AFE READY LED will illuminate.

The unit will re-charge automatically and close the circuit-breakers if the main supply voltage has been cut and turned back on (e.g. voltage drop in the network). The 0-1-Start switch has to be in position *1* which enables automatic function.

Turning the switch –S10 to position *0* will open the circuit-breaker even if the *REM-MAN-AUTO* selector switch is in *AUTO* position.

7.1.4 Circuit-Breaker TRIP due to overload or short-circuit

The electronic trip unit will open/trip the circuit-breaker in case of an overload or short circuit. The trip indication contacts of circuit-breakers are connected in series and if one of the circuit-breakers trips due to an overload or short circuit current, it will automatically open/trip the other circuit-breakers. The *MCCB FAULT LED* will illuminate and indicate that the circuit breakers are in tripped state.

Figure 7-5. MCCB FAULT indicator

In case of an overcurrent situation the fault that caused the circuit-breaker to trip should be identified and removed before the circuit-breakers can be reset. The MCCB can only be reset by pressing the push button -S6 when the –S11 *REM-MAN-AUTO* switch is in *MAN* position.

Figure 7-6. MCCB Reset push-button (-S11)

This will reset the circuit-breaker and, at the same time in FR9, FR10 or FR12 solution, recharge the spring system of the motor operators. After this it is possible to pre-charge and close the circuit-breakers by methods described in previous chapters.

8. INSTALLATION INSTRUCTIONS

1 Before starting the installation, check that none of the components of the frequency converter is live.

2 Make sure that the space where the converter is installed, and the converter itself, is clean and free from particles, dust or humidity that could harm the converter when it is powered on.

3 Make sure the connection of the AC choke and the optional 230V auxiliary voltage transformer are suitable for the supply voltage in use (See chapters 5.4 and 0).

4 Place the motor cables sufficiently far from other cables:

- **Avoid placing** the motor cables in long parallel lines with other cables
- If the motor cables run in parallel with other cables, note the **minimum distances** between the motor cables and other cables given in table below.

Distance between cables [m]	Shielded cable [m]
0.3	≤50
1.0	≤300

- The given distances also apply between the motor cables and signal cables of other systems.
- **The maximum length of the motor cables is 300m.**
  If output du/dt filters (+ODU or +ODC options) are used the cable length is limited according to the table below:

Maximum cable length with du/dt filter	Switching frequency
100m	3,6kHz
300m	1,5kHz

- The **motor cables should cross** other cables at an angle of 90 degrees.

5 If **cable insulation checks** are needed, see Chapter 8.1.1.

Continues on the next page

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	6	Connect the cables: ▪ **Strip the motor and mains cables** ▪ Remove the protection grids for the input terminals and the protection covers on the converter module(s). ▪ Pull the cable through the bottom plate and **fix the PE conductor to the PE bar of the cabinet**. ▪ **Connect the mains, motor and control cables** into their respective terminals. Use cable lugs on the power cables. In units with parallel cables (FR11 and FR12) make sure the cabling is fully symmetrical. ▪ **Fix the shields of the motor cable(s) to the cabinet** by using the earthing clamps included in the delivery. ▪ For Information on **cable installation according to UL regulations** see Chapter 8.1. ▪ **Make sure** that the control cable wires do not come in contact with the electronic components of the unit or control components inside the cabinet. ▪ If an **external brake resistor** (option) is used, connect its cable to the appropriate terminal **(R+/R–)**. Also make sure that the converter is equipped with a brake chopper (indicated in the type code of the converter). ▪ **Check the connection** of the earth cable to the motor and the frequency converter terminals marked with PE or ⏚. ▪ Connect the **separate shield of the power cable** to the earth terminals of the frequency converter, motor and the supply centre.
	7	**IMPORTANT:** If an output filter (+ODU, +ODC or +OSI) is used, note that the switching frequency of the converter (parameter 2.6.9, ID601) must be set according to the specification of the output filter. Setting too high/low a switching frequency may damage the filter.

8.1 Cable installation and the UL standards

To meet the UL (Underwriters Laboratories) regulations, a UL-approved copper cable with a minimum heat-resistance of +60/75°C must be used. The cable must be suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600V maximum. Use Class 1 wire only.

The tightening torques of the terminals are given in Table 8-1.

Type	Frame	Tightening torque [Nm]
NX_2 0261—0300 NX_5 0261—0300 NX_6 0125—0208	FR9	40/22*
NX_5 0385—1450	FR10-14	40**
NX_6 0261—1180	FR10-14	40**

Table 8-1. Tightening torques of terminals

* Tightening torque of terminal connection to the isolative base in Nm/in-lbs. NOTE: This value is needed only if the motor connection is made directly to the converter (no devices between converter and motor).
** Apply counter torque to the nut on the other side of the terminal when tightening/loosening the terminal screw in order to avoid damage to the terminal.

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8.1.1 Cable and motor insulation checks

1. Motor cable insulation checks

   Disconnect the motor cable from terminals U, V and W of the frequency converter and from the motor. Measure the insulation resistance of the motor cable between each phase conductor as well as between each phase conductor and the protective ground conductor.

   The insulation resistance must be >1MΩ.

2. Mains cable insulation checks

   Disconnect the mains cable from terminals L1, L2 and L3 of the frequency converter and from the mains. Measure the insulation resistance of the mains cable between each phase conductor as well as between each phase conductor and the protective ground conductor.

   The insulation resistance must be >1MΩ.

3. Brake resistor cable insulation checks

   Disconnect the brake resistor cable from terminals R+ and R- of the frequency converter and from the brake resistor. Measure the insulation resistance of the cable between each conductor as well as between conductors and the protective ground conductor.

   The insulation resistance must be >1MΩ.

4. Motor insulation checks

   Disconnect the motor cable from the motor and open the bridging connections in the motor connection box. Measure the insulation resistance of each motor winding. The measurement voltage must equal at least the motor nominal voltage but not exceed 1000 V. The insulation resistance must be >1MΩ.

5. Brake resistor insulation check

   Disconnect the brake resistor cable and measure the insulation from the power terminals to the ground terminal. The measurement voltage must equal at least the motor nominal voltage but not exceed 1000 V. The insulation resistance must be >1MΩ.

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8.2 Control unit

The control unit of the frequency converter consists roughly of the control board and additional boards (see Figure 8-1 and Figure 8-2) connected to the five *slot connectors* (A to E) of the control board. The control board is connected to the power unit through a D-connector (1) or fibre optic cables.

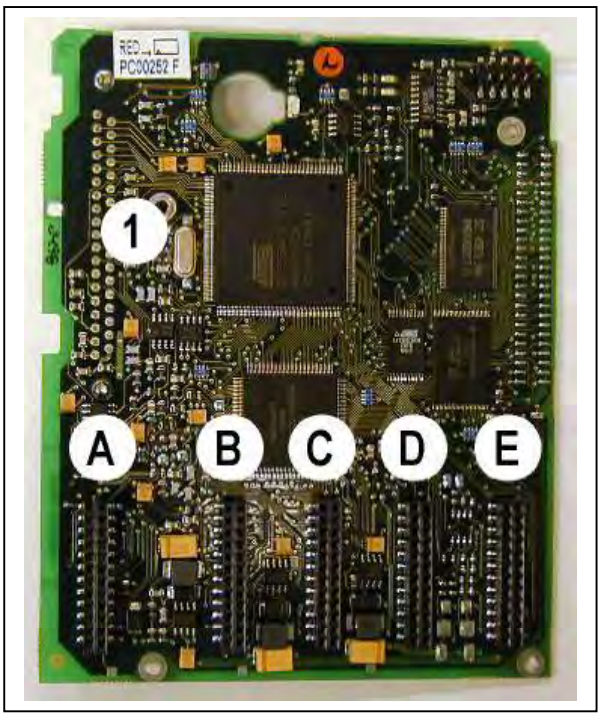


Figure 8-1. NX control board

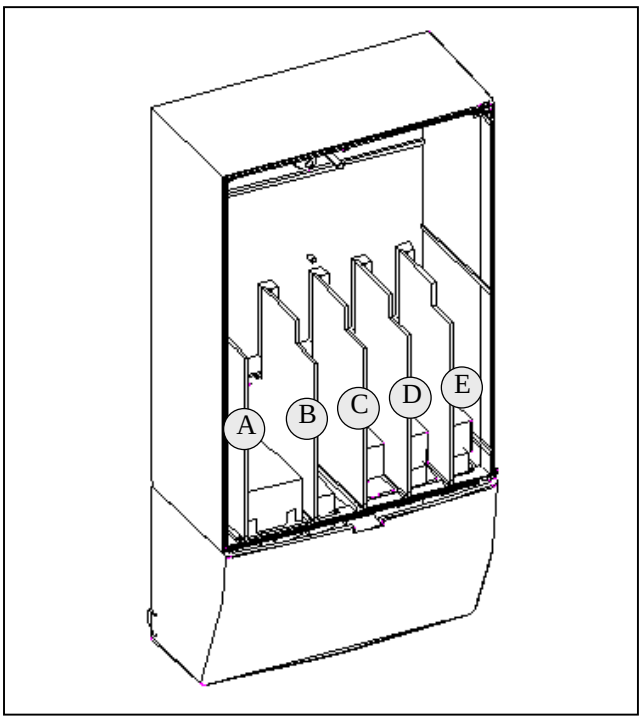


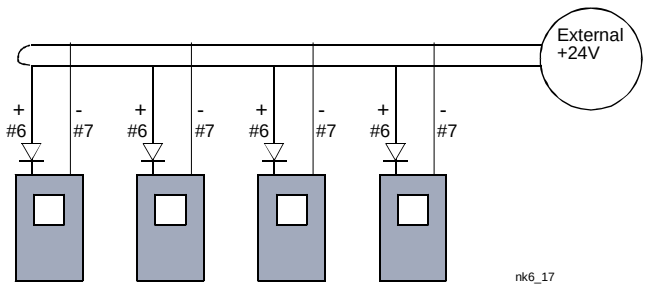
Figure 8-2. Basic and option board connections on the control board

Usually, when the frequency converter is delivered from the factory, the control unit includes at least the standard compilation of two basic boards (I/O board and relay board) which are normally installed in slots A and B. On the next pages you will find the arrangement of the control I/O and the relay terminals of the two basic boards, the general wiring diagram and the control signal descriptions. The I/O boards mounted at the factory are indicated in the type code. For more information on the option boards, see Vacon NX option board manual (ud741).

The control board can be powered externally (+24V, ±10%) by connecting the external power source to either of the bidirectional terminala #6 or #12, see page 59. This voltage is sufficient for parameter setting and for keeping the fieldbus active.

Note! Each AFE module of a NXC regenerative low-harmonic drive has its own control unit. The three basic boards A1,A2 and B5 are included as standard. AFE control usually needs to be parameterized only once during the commissioning of the drive.

Note! If the 24V inputs of several frequency converters are parallelly connected we recommend to use a diode in terminal #6 (or #12) in order to avoid the current to flow in opposite direction. This might damage the control board. See picture below.



8.2.1 Control connections

The basic control connections for boards A1 and A2/A3 are shown in Chapter 8.2.2.
The signal descriptions are presented in the All in One Application Manual.

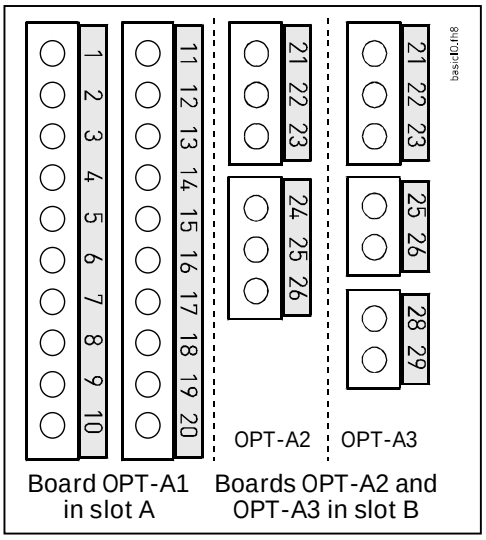


Figure 8-3. The I/O terminals of the basic boards

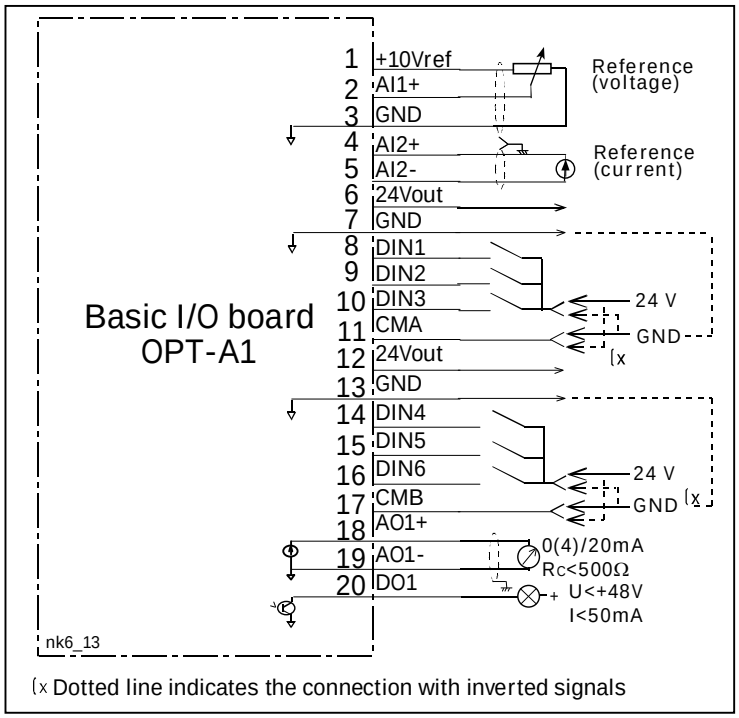


Figure 8-4. General wiring diagram of the basic I/O board (OPT-A1)

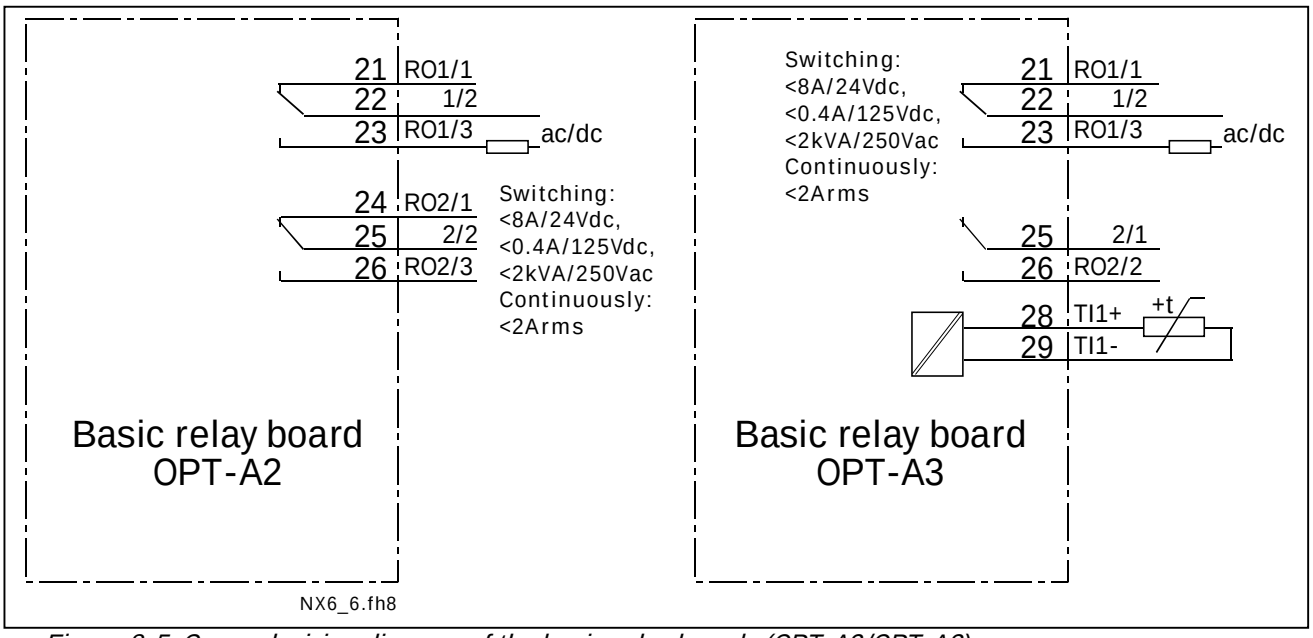


Figure 8-5. General wiring diagram of the basic relay boards (OPT-A2/OPT-A3)

8.2.1.1 Control cables

The control cables shall be at least 0.5 mm^2 screened multicore cables, see Table 6-1. The maximum terminal wire size is 2.5 mm^2 for the relay terminals and 1.5 mm^2 for other terminals.

Find the tightening torques of the option board terminals in Table below.

Terminal screw	Tightening torque	
	Nm	lb-in.
Relay and thermistor terminals (screw M3)	0.5	4.5
Other terminals (screw M2.6)	0.2	1.8

Table 8-2. Tightening torques of terminals

8.2.1.2 Galvanic isolation barriers

The control connections are isolated from the mains potential and the GND terminals are permanently connected to ground. See Figure 8-6.
The digital inputs are galvanically isolated from the I/O ground. The relay outputs are additionally double-isolated from each other at 300VAC (EN-50178).

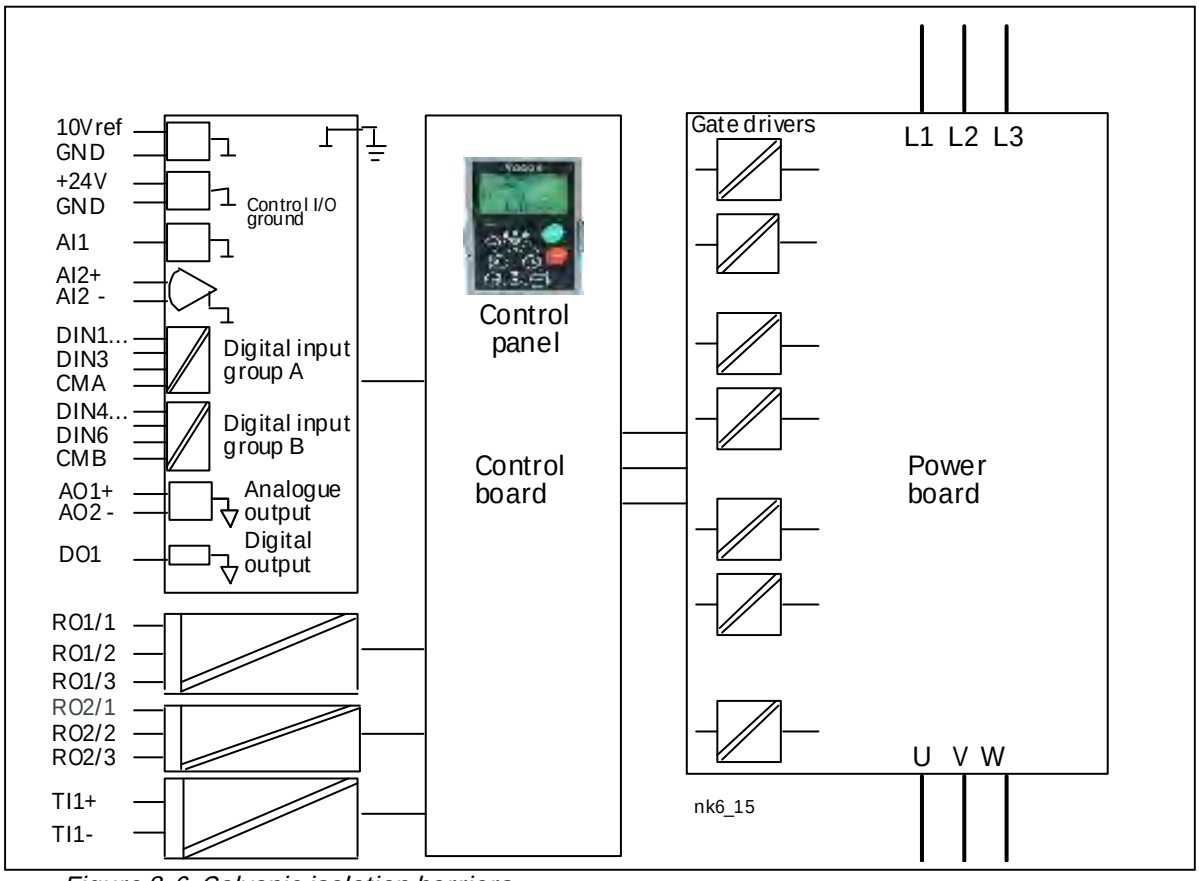


Figure 8-6. Galvanic isolation barriers

8.2.2 Control terminal signals

OPT-A1			
Terminal		Signal	Technical information
1	+10 Vref	Reference voltage	Maximum current 10 mA
2	AI1+	Analogue input, voltage or current	Selection V or mA with jumper block X1 (see page 62): Default: 0– +10V (Ri = 200 kΩ) (-10V.....+10V Joy-stick control, selected with a jumper) 0– 20mA (Ri = 250 Ω)
3	GND/AI1–	Analogue input common	Differential input if not connected to ground; Allows ±20V differential mode voltage to GND
4	AI2+	Analogue input, voltage or current	Selection V or mA with jumper block X2 (see page 62): Default: 0– 20mA (Ri = 250 Ω) 0– +10V (Ri = 200 kΩ) (-10V.....+10V Joy-stick control, selected with a jumper)
5	GND/AI2–	Analogue input common	Differential input if not connected to ground; Allows ±20V differential mode voltage to GND
6	24 Vout (bidirectional)	24V auxiliary voltage	±15%, maximum current 250mA (all boards total);150mA (from single board); Can also be used as external power backup for the control unit (and fieldbus)
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Digital input 1	R_i = min. 5kΩ 18...30V = "1"
9	DIN2	Digital input 2	
10	DIN3	Digital input 3	
11	CMA	Digital input common A for DIN1, DIN2 and DIN3.	Must be connected to GND or 24V of I/O terminal or to external 24V or GND Selection with jumper block X3 (see page 62):
12	24 Vout (bidirectional)	24V auxiliary voltage	Same as terminal #6
13	GND	I/O ground	Same as terminal #7
14	DIN4	Digital input 4	R_i = min. 5kΩ 18...30V = "1"
15	DIN5	Digital input 5	
16	DIN6	Digital input 6	
17	CMB	Digital input common B for DIN4, DIN5 and DIN6	Must be connected to GND or 24V of I/O terminal or to external 24V or GND Selection with jumper block X3 (see page 62):
18	AO1+	Analogue signal (+output)	Output signal range: Current 0(4)–20mA, R_L max 500Ω or Voltage 0—10V, R_L >1kΩ Selection with jumper block X6 (see page 62):
19	AO1–	Analogue output common	
20	DO1	Open collector output	Maximum U_{in} = 48VDC Maximum current = 50 mA

Table 8-3. Control I/O terminal signals on basic I/O board OPT-A1

OPT-A2				
Terminal		Signal	Technical information	
21	RO1/1	Relay output 1	Switching capacity	24VDC/8A
22	RO1/2			250VAC/8A
23	RO1/3			125VDC/0.4A
			Min.switching load	5V/10mA
24	RO2/1	Relay output 2	Switching capacity	24VDC/8A
25	RO2/2			250VAC/8A
26	RO2/3			125VDC/0.4A
			Min.switching load	5V/10mA

Table 8-4. Control I/O terminal signals on basic relay board OPT-A2

OPT-A3				
Terminal		Signal	Technical information	
21	RO1/1	Relay output 1	Switching capacity	24VDC/8A
22	RO1/2			250VAC/8A
23	RO1/3			125VDC/0.4A
			Min.switching load	5V/10mA
25	RO2/1	Relay output 2	Switching capacity	24VDC/8A
26	RO2/2			250VAC/8A
				125VDC/0.4A
			Min.switching load	5V/10mA
28	TI1+	Thermistor input		
29	TI1–			

Table 8-5. Control I/O terminal signals on basic relay board OPT-A3

8.2.2.1 Digital input signal inversions

The active signal level depends on which potential the common inputs CMA and CMB (terminals 11 and 17) are connected to. The alternatives are either +24V or ground (0 V). See Figure 8-7.

The 24-volt control voltage and the ground for the digital inputs and the common inputs (CMA, CMB) can be either internal or external.

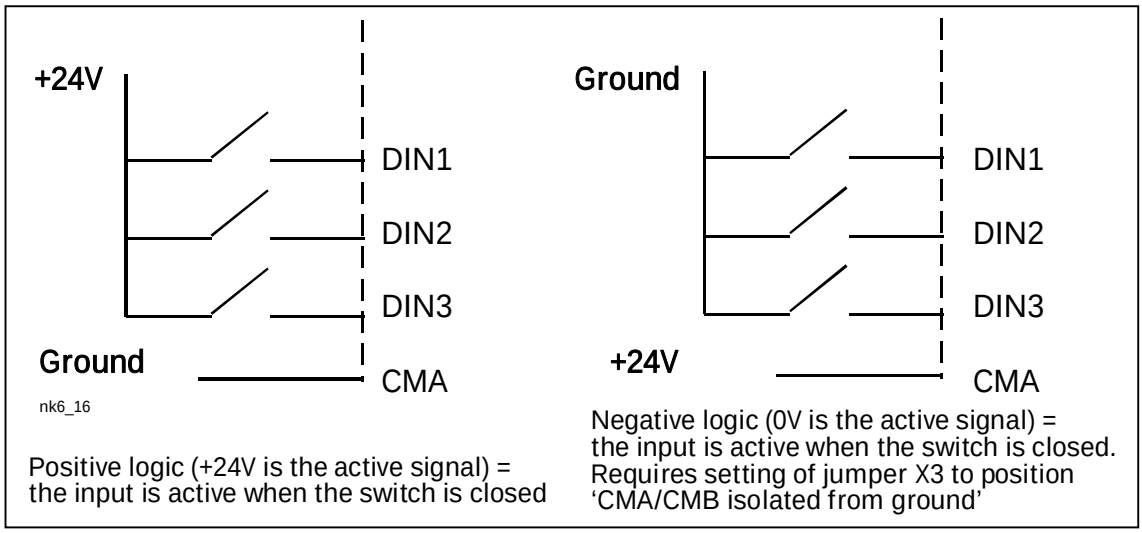


Figure 8-7. Positive/Negative logic

8.2.2.2 Jumper selections on the OPT-A1 basic board

The user is able to customise the functions of the frequency converter to better suit his needs by selecting certain positions for the jumpers on the OPT-A1 board. The positions of the jumpers determine the signal type of analogue and digital inputs.

On the A1 basic board, there are four jumper blocks X1, X2, X3 and X6 each containing eight pins and two jumpers. The selectable positions of the jumpers are shown in Figure 8-9.

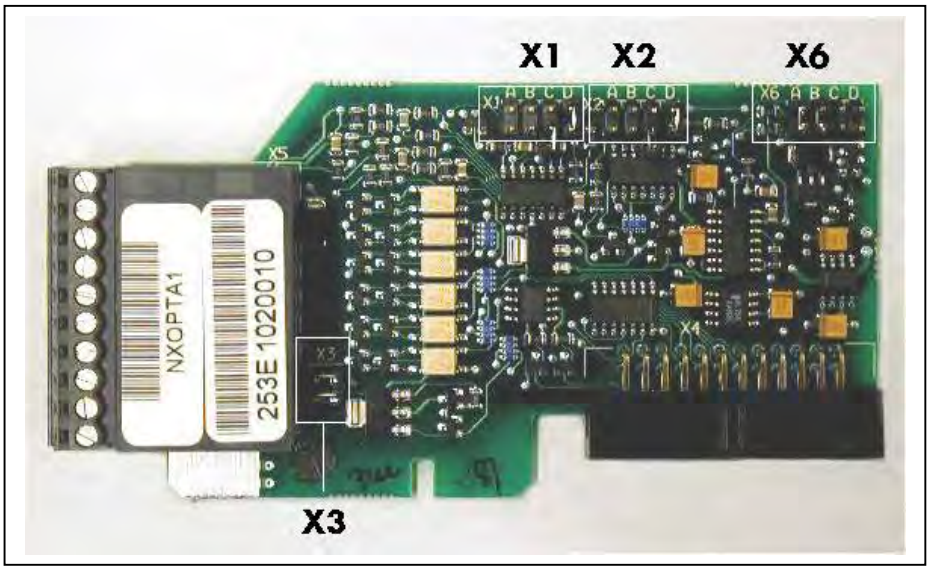


Figure 8-8. Jumper blocks on OPT-A1

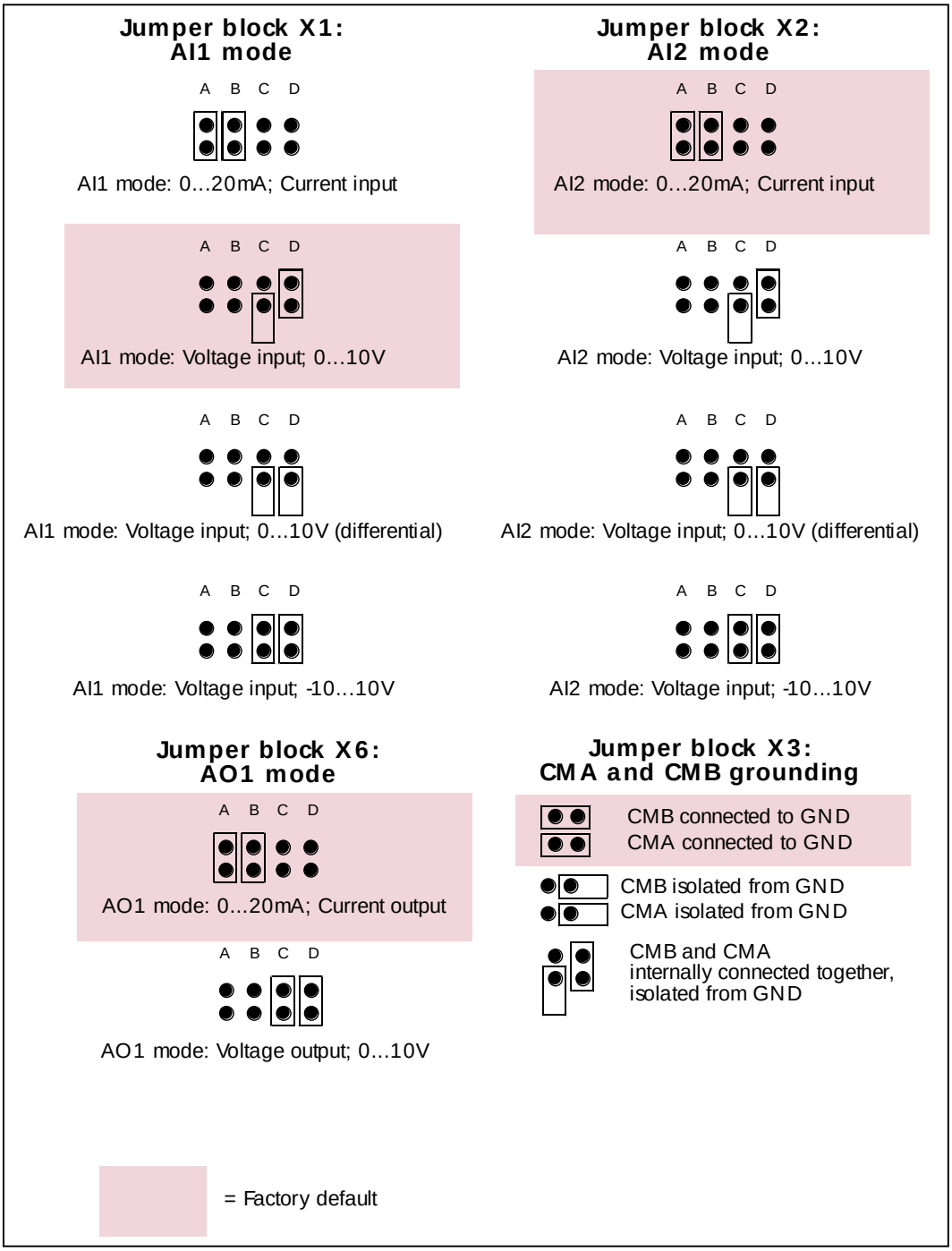


Figure 8-9. Jumper selection for OPT-A1

If you change the AI/AO signal content also remember to change the corresponding board parameter in menu M7.

8.3 Connecting power supply and internal control cables

You might need to establish the fibre cable connections from the star coupler board to the power module. Connect the cables according to Figure 8-11.

The control unit uses 24 VDC supplied from the ASIC board, which is located on the left side of the power unit 1. To access the board, remove the protective cover in front of the power module. Connect the power supply cable to the X10 connector on the ASIC board and to the X2 connector on the rear side of the control unit.

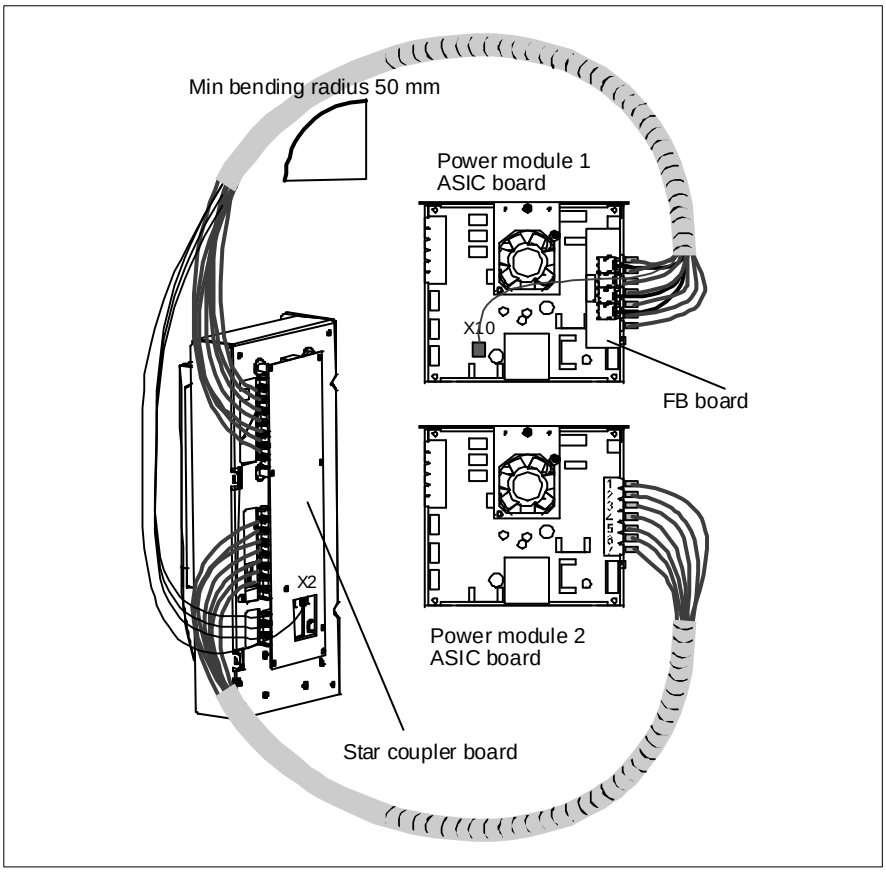


Figure 8-10. Connecting the power supply and control cables to the control unit, FR12

Each fibre optic cable has a number 1...8 and 11...18 marked on the cable shield at both cable ends. Connect each cable to the connectors marked with the same number on the ASIC board and on the rear side of the control unit. Additionally, you may have to connect the 4 fibre cables from the feedback board to the star coupler board. The list of the optic signals can be found in chapter 8.4.

CAUTION! Be careful when connecting the fibre optic cables! Connecting the wires incorrectly will damage power electronic components.

NOTE! The minimum bending radius for optical cables is 50mm.

Fix the cable bundle at two or more points, at least one at each end, to prevent damages to the cables.

Fasten the protective cover on the power unit when the work is finished.

8.4 Optic fibre cables, signal listing and connections

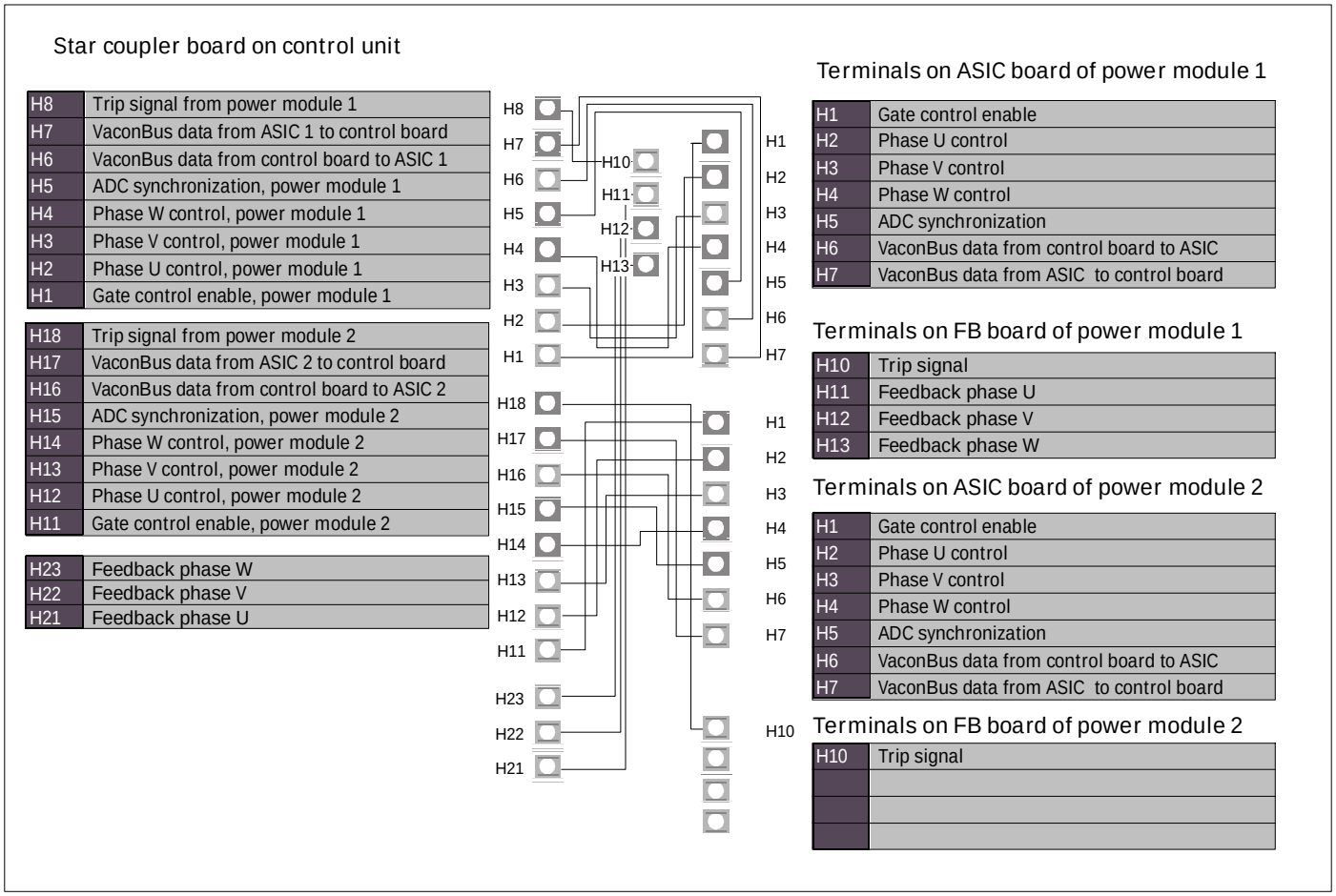

Star coupler board on control unit
H8 Trip signal from power module 1
H7 VaconBus data from ASIC 1 to control board
H6 VaconBus data from control board to ASIC 1
H5 ADC synchronization, power module 1
H4 Phase W control, power module 1
H3 Phase V control, power module 1
H2 Phase U control, power module 1
H1 Gate control enable, power module 1
H18 Trip signal from power module 2
H17 VaconBus data from ASIC 2 to control board
H16 VaconBus data from control board to ASIC 2
H15 ADC synchronization, power module 2
H14 Phase W control, power module 2
H13 Phase V control, power module 2
H12 Phase U control, power module 2
H11 Gate control enable, power module 2
H23 Feedback phase W
H22 Feedback phase V
H21 Feedback phase U
H8 H7 H6 H5 H4 H3 H2 H1
H10 H11 H12 H13
H1 H2 H3 H4 H5 H6 H7
H18 H17 H16 H15 H14 H13 H12 H11
H1 H2 H3 H4 H5 H6 H7
H23 H22 H21
H10
Terminals on ASIC board of power module 1
H1 Gate control enable
H2 Phase U control
H3 Phase V control
H4 Phase W control
H5 ADC synchronization
H6 VaconBus data from control board to ASIC
H7 VaconBus data from ASIC to control board
Terminals on FB board of power module 1
H10 Trip signal
H11 Feedback phase U
H12 Feedback phase V
H13 Feedback phase W
Terminals on ASIC board of power module 2
H1 Gate control enable
H2 Phase U control
H3 Phase V control
H4 Phase W control
H5 ADC synchronization
H6 VaconBus data from control board to ASIC
H7 VaconBus data from ASIC to control board
Terminals on FB board of power module 2
H10 Trip signal

Figure 8-11. Internal fibre cable connections

9. CONTROL KEYPAD

The control keypad is the link between the Vacon frequency converter and the user. The Vacon NX control keypad features an alphanumeric display with seven indicators for the Run status (RUN, , READY, STOP, ALARM, FAULT) and three indicators for the control place (I/O term/ Keypad/BusComm). There are also three Status Indicator LEDs (green - green - red), see Status LEDs (green – green – red) below.
The control information, i.e. the number of menu, description of menu or the displayed value and the numeric information are presented on three text lines.

The frequency converter is operable through the nine push-buttons of the control keypad. Furthermore, the buttons serve the purposes of parameter setting and value monitoring.

The keypad is detachable and isolated from the input line potential.

9.1 Indications on the Keypad display

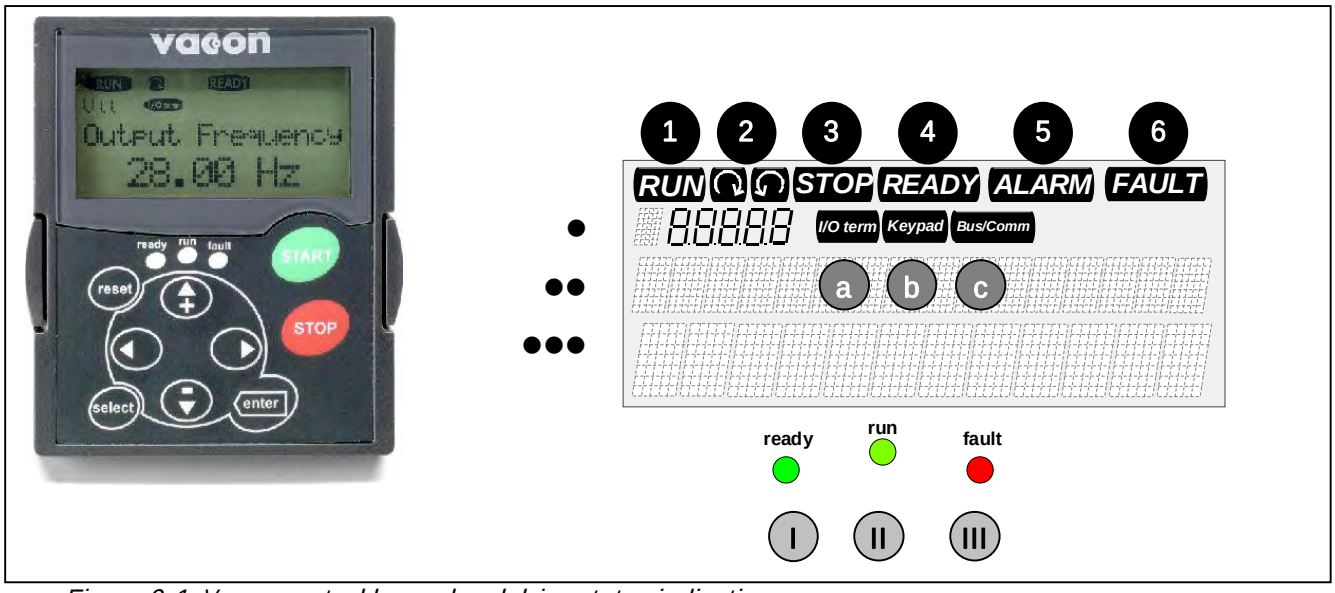


Figure 9-1. Vacon control keypad and drive status indications

9.1.1 Drive status indications

The drive status indications tell the user what the status of the motor and the drive is and whether the motor control software has detected irregularities in motor or frequency converter functions.

1 RUN = Motor is running; Blinks when the stop command has been given but the frequency is still ramping down.

2 = Indicates the direction of motor rotation.

3 STOP = Indicates that the drive is not running.

4 READY = Lights when AC power is on. In case of a trip, the symbol will not light up.

5 ALARM = Indicates that the drive is running outside a certain limit and a warning is given.

6 FAULT = Indicates that unsafe operating conditions were encountered due to which the drive was stopped.

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9.1.2 Control place indications

The symbols ***I/O term***, ***Keypad*** and ***Bus/Comm*** (see Figure 9-1) indicate the choice of control place made in the Keypad control menu (M3) (see chapter 9.3.3).

a ***I/O term*** = I/O terminals are the selected control place; i.e. START/STOP commands or reference values etc. are given through the I/O terminals.

b ***Keypad*** = Control keypad is the selected control place; i.e. the motor can be started or stopped, or its reference values etc. altered from the keypad.

c ***Bus/Comm*** = The frequency converter is controlled through a fieldbus.

9.1.3 Status LEDs (green – green – red)

The status LEDs light up in connection with the READY, RUN and FAULT drive status indicators.

I = Illuminates with the AC power connected to the drive and no faults are active. Simultaneously, the drive status indicator READY is lit up.

II = Illuminates when the drive is running. Blinks when the STOP button has been pushed and the drive is ramping down.

III = Blinks when unsafe operating conditions were encountered due to which the drive was stopped (Fault Trip). Simultaneously, the drive status indicator FAULT blinks on the display and the fault description can be seen, see chapter 9.3.4, Active Faults.

9.1.4 Text lines

The three text lines (•, ••, •••) provide the user with information on his present location in the keypad menu structure as well as with information related to the operation of the drive.

• = Location indication; displays the symbol and number of menu, parameter etc. Example: **M2** = Menu 2 (Parameters); **P2.1.3** = Acceleration time

•• = Description line; Displays the description of menu, value or fault.

••• = Value line; Displays the numerical and textual values of references, parameters etc. and the number of submenus available in each menu.

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9.2 Keypad push-buttons

The Vacon alphanumeric control keypad features 9 push-buttons that are used for the control of the frequency converter (and motor), parameter setting and value monitoring.

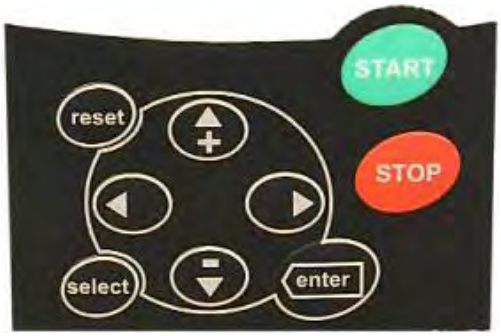

Figure 9-2. Keypad push-buttons

9.2.1 Button descriptions

reset	=	This button is used to reset active faults (see Chapter 9.3.4).
select	=	This button is used to switch between two latest displays. May be useful when you want to see how the changed new value influences some other value.
enter	=	The Enter button serves for: 1) confirmation of selections 2) fault history reset (2...3 seconds)
▲ +	=	Browser button up Browse the main menu and the pages of different submenus. Edit values.
- ▼	=	Browser button down Browse the main menu and the pages of different submenus. Edit values.
◄	=	Menu button left Move backward in menu. Move cursor left (in parameter menu). Exit edit mode. Hold down for 3 seconds to return to main menu.
►	=	Menu button right Move forward in menu. Move cursor right (in parameter menu). Enter edit mode.
start	=	Start button. Pressing this button starts the motor if the keypad is the active control place. See Chapter 9.3.3.
stop	=	Stop button. Pressing this button stops the motor (unless disabled by parameter R3.4/R3.6). See Chapter 9.3.3.

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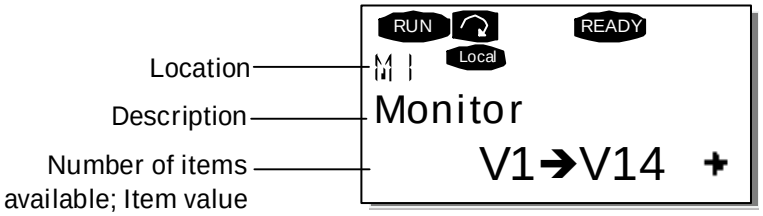
9.3 Navigation on the control keypad

The data on the control keypad are arranged in menus and submenus. The menus are used for example for the display and editing of measurement and control signals, parameter settings (chapter 9.3.2), reference values and fault displays (chapter 9.3.4). Through the menus, you can also adjust the contrast of the display (page 87).



The first menu level consists of menus M1 to M7 and is called the *Main menu*. The user can navigate in the main menu using the *Browser buttons* up and down. The desired submenu can be entered from the main menu using the *Menu buttons*. When there still are pages to enter under the currently displayed menu or page, you can see an arrow (+) in the lower right corner of the display and by pressing the *Menu button right*, you can reach the next menu level.

The control keypad navigation chart is shown on the next page. Please note that the menu ***M1*** is located in the lower left corner. From there you will be able to navigate your way up to the desired menu using the menu and browser buttons.

More detailed descriptions of the menus you will find later in this Chapter.

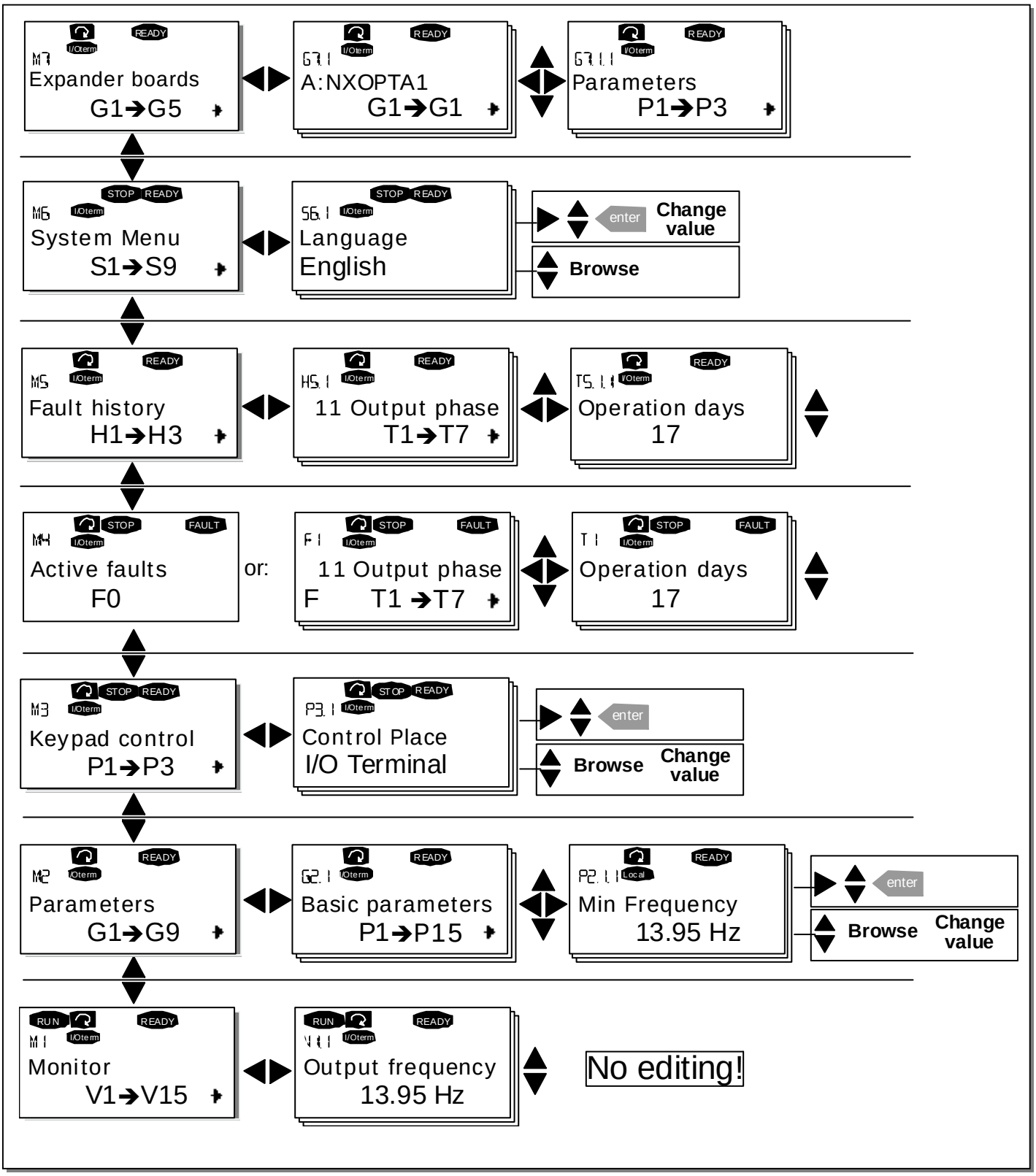


Figure 9-3. Keypad navigation chart

9.3.1 Monitoring menu (M1)

You can enter the Monitoring menu from the Main menu by pushing the *Menu button right* when the location indication **M1** is visible on the first line of the display. How to browse through the monitored values is presented in Figure 9-4.
The monitored signals carry the indication **V#.#** and they are listed in Table 9-1. The values are updated once every 0.3 seconds.

This menu is meant only for signal checking. The values cannot be altered here. For changing values of parameters see Chapter 9.3.2.

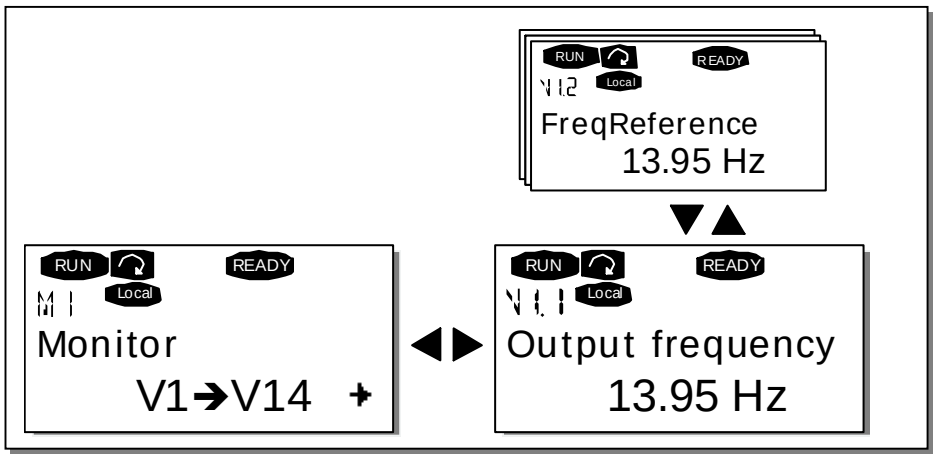


Figure 9-4. Monitoring menu

Code	Signal name	Unit	Description
V1.1	Output frequency	Hz	Frequency to the motor
V1.2	Frequency reference	Hz	
V1.3	Motor speed	rpm	Calculated motor speed
V1.4	Motor current	A	Measured motor current
V1.5	Motor torque	%	Calculated motor shaft torque
V1.6	Motor power	%	Calculated motor shaft power
V1.7	Motor voltage	V	Calculated motor voltage
V1.8	DC-link voltage	V	Measured DC-link voltage
V1.9	Unit temperature	ºC	Heat sink temperature
V1.10	Motor temperature	%	Calculated motor temperature. See All in One application manual
V1.11	Voltage input	V	AI1
V1.12	Current input	mA	AI2
V1.13	DIN1, DIN2, DIN3		Digital input statuses
V1.14	DIN4, DIN5, DIN6		Digital input statuses
V1.15	DO1, RO1, RO2		Digital and relay output statuses
V1.16	Analogue output current	mA	AO1
M1.17	Multimonitoring items		Displays three selectable monitoring values. See chapter 9.3.6.5.

Table 9-1. Monitored signals

Note: The All in One applications embody more monitoring values.

9.3.2 Parameter menu (M2)

Parameters are the way of conveying the commands of the user to the frequency converter. The parameter values can be edited by entering the *Parameter Menu* from the *Main Menu* when the location indication **M2** is visible on the first line of the display. The value editing procedure is presented in Figure 9-5.

Push the *Menu button right* once to move into the *Parameter Group Menu (G#)*. Locate the parameter group desired by using the *Browser buttons* and push the *Menu button right* again to enter the group and its parameters. Use again the *Browser buttons* to find the parameter *(P#)* you want to edit. From here you can proceed in two different ways: Pushing the *Menu button right* takes you to the edit mode. As a sign of this, the parameter value starts to blink. You can now change the value in two different manners:

1. Just set the new desired value with the *Browser buttons* and confirm the change with the *Enter button*. Consequently, the blinking stops and the new value is visible in the value field.
2. Push the *Menu button right* once again. Now you will be able to edit the value digit by digit. This editing manner may come in handy, when a relatively greater or smaller value than that on the display is desired. Confirm the change with the *Enter button*.

The value will not change unless the Enter button is pushed. Pressing the *Menu button left* takes you back to the previous menu.

Several parameters are locked, i.e. uneditable, when the drive is in RUN status. If you try to change the value of such a parameter the text **Locked** will appear on the display. The frequency converter must be stopped in order to edit these parameters.
The parameters values can also be locked using the function in menu **M6** (see Chapter Parameter lock (P6.5.2)).

You can return to the *Main menu* anytime by pressing the *Menu button left* for 3 seconds.

The basic application package "All in One" includes seven applications with different sets of parameters. See the All in One Application manual for closer information.

Once in the last parameter of a parameter group, you can move directly to the first parameter of that group by pushing the *Browser button up*.

See the diagram for parameter value change procedure on page 72.

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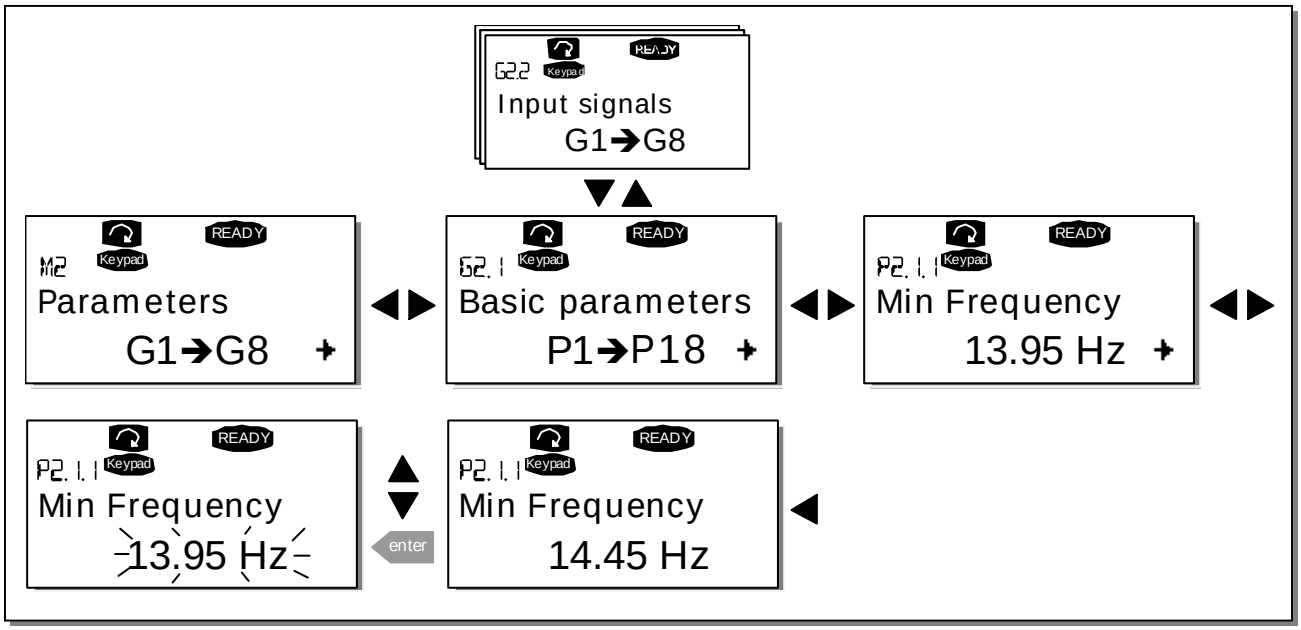

Figure 9-5. Parameter value change procedure

9.3.3 Keypad control menu (M3)

In the *Keypad Controls Menu*, you can choose the control place, edit the frequency reference and change the direction of the motor. Enter the submenu level with the *Menu button right*.

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Note
P3.1	Control place	1	3		1		125	**1**=I/O terminal **2**=Keypad **3**=Fieldbus
R3.2	Keypad reference	Par. 2.1.1	Par. 2.1.2	Hz				
P3.3	Direction (on keypad)	0	1		0		123	**0**=Forward **1**=Reverse
R3.4	Stop button	0	1		1		114	**0**=Limited function of Stop button **1**=Stop button always enabled

Table 9-2. Keypad control parameters, M3

9.3.3.1 Selection of control place

There are three different places (sources) which the frequency converter can be controlled from. For each control place, a different symbol will appear on the alphanumeric display:

Control place	Symbol
I/O terminals	I/O term
Keypad (panel)	Keypad
Fieldbus	Bus/Comm

Change the control place by entering the edit mode with the *Menu button right*. The options can then be browsed through with the *Browser buttons*. Select the desired control place with the *Enter button*. See the diagram on the next page. See also 9.3.3 above.

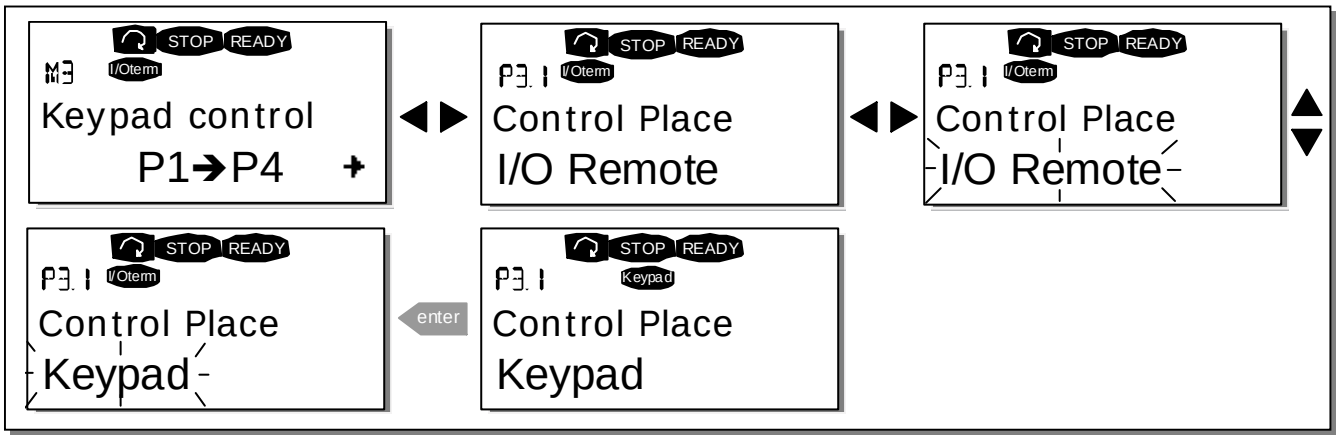

Figure 9-6. Selection of control place

9.3.3.2 *Keypad reference*

The keypad reference submenu **(P3.2)** displays and allows the operator to edit the frequency reference. The changes will take place immediately. **This reference value will not, however, influence the rotation speed of the motor unless the keypad has been selected as source of reference.**
NOTE: The maximum difference in RUN mode between the output frequency and the keypad reference is 6 Hz.

See Figure 9-5 for how to edit the reference value (pressing the *Enter button* is not, however, necessary).

9.3.3.3 *Keypad direction*

The keypad direction submenu displays and allows the operator to change the rotating direction of the motor. **This setting will not, however, influence the rotation direction of the motor unless the keypad has been selected as the active control place.**

See Figure 9-6 for how to change the rotation direction.

> **Note:** Additional information on controlling the motor with the keypad is given in Chapters 9.2.1 and 10.2.

9.3.3.4 *Stop button activated*

By default, pushing the STOP button will **always** stop the motor regardless of the selected control place. You can disable this function by giving parameter 3.4 the value **0**. If the value of this parameter is **0**, the STOP button will stop the motor only **when the keypad has been selected as the active control place.**

> **NOTE!** There are some special functions that can be performed when in the ***M3*** menu:
>
> **Select the keypad as the active control place** by keeping the start button pushed down for 3 seconds **when the motor is running**. The keypad will become the active control place and the current frequency reference and direction will be copied to the keypad.
>
> **Select the keypad as the active control place** by keeping the stop button pushed down for 3 seconds **when the motor is stopped**. The keypad will become the active control place and the current frequency reference and direction will be copied to the keypad.
>
> **Copy the frequency reference set elsewhere** (I/O, fieldbus) **to the panel** by keeping the enter button pushed down for 3 seconds.
>
> **Note that** if you are in any other than ***M3*** menu these functions will not work.
> If you are in some other than ***M3*** menu and try to start the motor by pressing the START button when the keypad is not selected as the active control place you will get an error message *Keypad Control NOT ACTIVE*.

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9.3.4 Active faults menu (M4)

The *Active faults menu* can be entered from the *Main menu* by pushing the *Menu button right* when the location indication **M4** is visible on the first line of the keypad display.

When a fault brings the frequency converter to a stop, the location indication F1, the fault code, a short description of the fault and the **fault type symbol** (see Chapter 9.3.4.1) will appear on the display. In addition, the indication FAULT or ALARM (see Figure 9-1 or Chapter 9.1.1) is displayed and, in case of a FAULT, the red led on the keypad starts to blink. If several faults occur simultaneously, the list of active faults can be browsed with the *Browser buttons*.

Find the fault codes in chapter 11.2, Table 11-2.

The memory of active faults can store the maximum of 10 faults in the order of appearance. The display can be cleared with the *Reset button* and the read-out will return to the same state it was before the fault trip. The fault remains active until it is cleared with the *Reset button* or with a reset signal from the I/O terminal or fieldbus.

Note! Remove external Start signal before resetting the fault to prevent unintentional restart of the drive.

Normal state, no faults:

9.3.4.1 Fault types

In the NX frequency converter, there are four different types of faults. These types differ from each other on the basis of the subsequent behaviour of the drive. See Table 9-3.

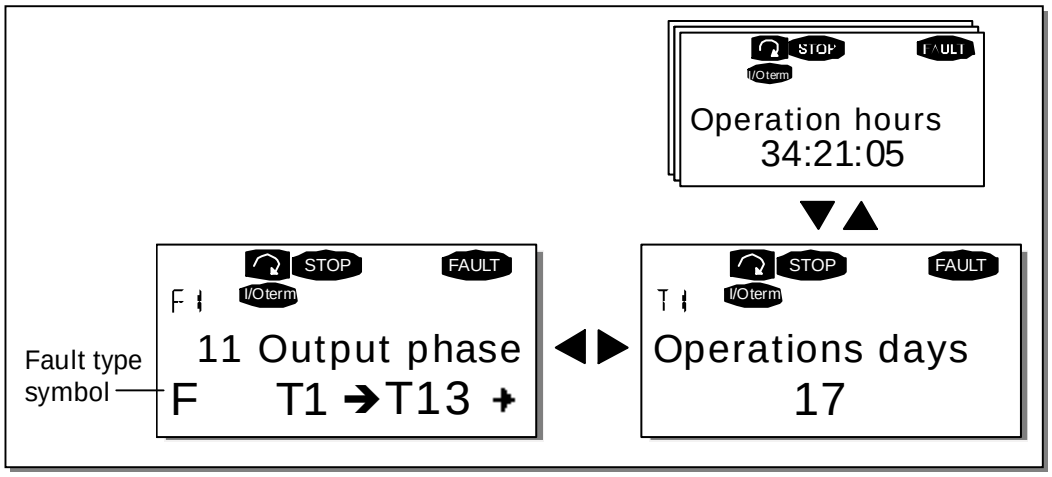

Figure 9-7. Fault display

Fault type symbol	Meaning
A (Alarm)	This type of fault is a sign of an unusual operating condition. It does not cause the drive to stop, nor does it require any special actions. The 'A fault' remains in the display for about 30 seconds.
F (Fault)	An 'F fault' is a kind of fault that makes the drive stop. Actions need to be taken in order to restart the drive.
AR (Fault Autoreset)	If an 'AR fault' occurs the drive will also stop immediately. The fault is reset automatically and the drive tries to restart the motor. Finally, if the restart is not successful, a fault trip (FT, see below) occurs.
FT (Fault Trip)	If the drive is unable to restart the motor after an AR fault an FT fault occurs. The effect of the 'FT fault' is basically the same as that of the F fault: the drive is stopped.

Table 9-3. Fault types

9.3.4.2 Fault time data record

When a fault occurs the information described above in 9.3.4 is displayed. By pushing the *Menu button right* here you will enter the *Fault time data record menu* indicated by **T.1→T.13**. In this menu, some selected important data valid at the time of the fault are recorded. This feature is intended to help the user or the service person to determine the cause of fault.

The data available are:

T.1	Counted operation days *(Fault 43: Additional code)*	d
T.2	Counted operation hours *(Fault 43: Counted operation days)*	hh:mm:ss *(d)*
T.3	Output frequency *(Fault 43: Counted operation hours)*	Hz *(hh:mm:ss)*
T.4	Motor current	A
T.5	Motor voltage	V
T.6	Motor power	%
T.7	Motor torque	%
T.8	DC voltage	V
T.9	Unit temperature	°C
T.10	Run status	
T.11	Direction	
T.12	Warnings	
T.13	0-speed*	

Table 9-4. Fault time recorded data

* Tells the user if the drive was at zero speed (< 0.01 Hz) when the fault occurred

9.3.4.3 Real time record

If real time is set to run on the frequency converter the data items **T1** and **T2** will appear as follows:

T.1	Counted operation days	yyyy-mm-dd
T.2	Counted operation hours	hh:mm:ss,sss

9.3.5 Fault history menu (M5)

The *Fault history menu* can be entered from the *Main menu* by pushing the *Menu button right* when the location indication **M5** is visible on the first line of the keypad display. Find the fault codes in Table 11-2.

All faults are stored in the *Fault history menu* in which you can browse through them using the *Browser buttons*. Additionally, the *Fault time data record* pages (see Chapter 9.3.4.2) are accessible at each fault. You can return to the previous menu anytime by pushing the *Menu button left*.

The memory of the frequency converter can store a maximum of 30 faults in the order of appearance. The number of faults currently in the fault history is shown on the value line of the main page (**H1→H#)**. The order of the faults is indicated by the location indication in the upper left corner of the display. The latest fault carries the indication F5.1, the second latest F5.2 etc. If there are 30 uncleared faults in the memory the next occurring fault will erase the oldest from the memory.

Pressing the *Enter button* for about 2 to 3 seconds resets the whole fault history. Then, the symbol **H#** will change to **0**.

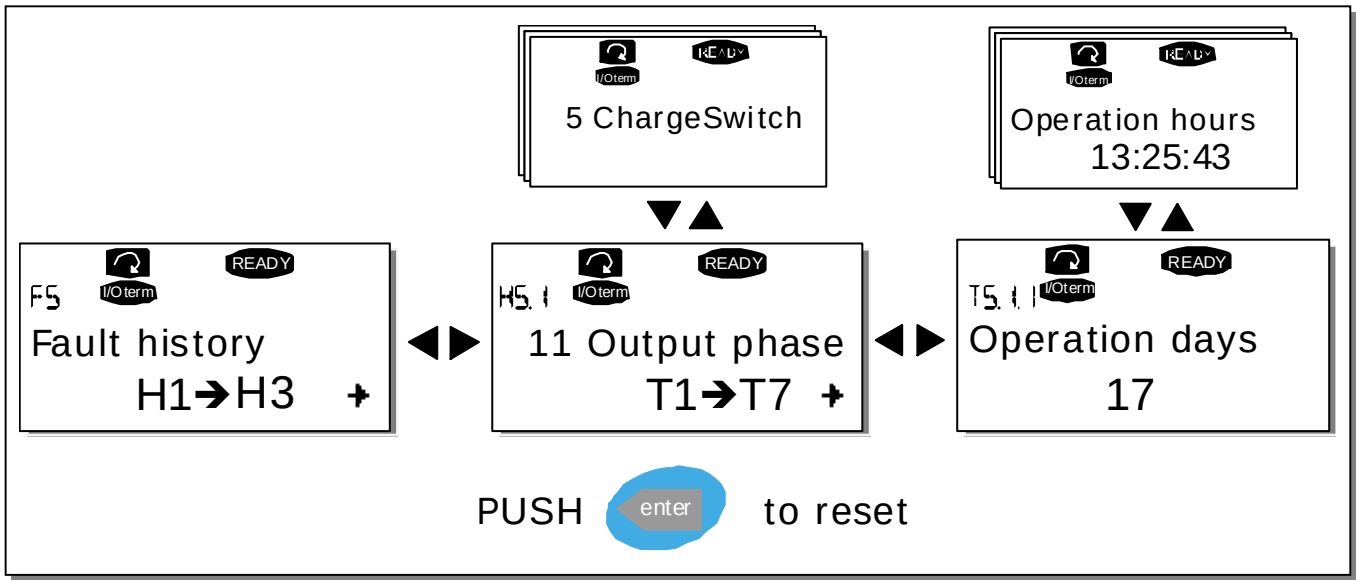

Figure 9-8. Fault history menu

9.3.6 System menu (M6)

The *System menu* can be entered from the main menu by pushing the *Menu button right* when the location indication **M6** is visible on the display.

The controls associated with the general use of the frequency converter, such as application selection, customised parameter sets or information about the hardware and software are located under the *System menu*. The number of submenus and subpages is shown with the symbol **S (or P)** on the value line.

Functions in the System menu

Code	Function	Min	Max	Unit	Default	Cust	Selections
S6.1	Language selection				English		Available selections depend on the language package.
S6.2	Application selection				Basic Application		Basic Application Standard Application Local/Remote control Appl. Multi-Step Application PID Control Application Multi-Purpose Control Appl. Pump and Fan Control Appl.
S6.3	Copy parameters						
S6.3.1	Parameter sets						Store set 1 Load set 1 Store set 2 Load set 2 Load factory defaults
S6.3.2	Load up to keypad						All parameters
S6.3.3	Load down from keypad						All parameters All but motor parameters Application parameters
P6.3.4	Parameter backup				Yes		Yes No
S6.4	Compare parameters						
S6.4.1	Set1				Not used		
S6.4.2	Set2				Not used		
S6.4.3	Factory settings						
S6.4.4	Keypad set						
S6.5	Security						
S6.5.1	Password				Not used		**0**=Not used
P6.5.2	Parameter lock				Change Enabled		Change Enabled Change Disabled
S6.5.3	Start-up wizard						No Yes
S6.5.4	Multimonitoring items						Change Enabled Change Disabled
S6.6	Keypad settings						
P6.6.1	Default page						
P6.6.2	Default page/ Operating menu						
P6.6.3	Timeout time	0	65535	s	30		
P6.6.4	Contrast	0	31		18		
P6.6.5	Backlight time	Always	65535	min	10		
S6.7	Hardware settings						
P6.7.1	Internal brake resistor				Connected		Not connected Connected
P6.7.2	Fan control				Continuous		Continuous Temperature

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P6.7.3	HMI acknowledg. timeout	200	5000	ms	200		
P6.7.4	HMI number of retries	1	10		5		
S6.8	System information						
S6.8.1	Total counters						
C6.8.1.1	MWh counter			kWh			
C6.8.1.2	Power On day counter						
C6.8.1.3	Power On hours counter			hh:mm:ss			
S6.8.2	Trip counters						
T6.8.2.1	MWh counter			kWh			
T6.8.2.2	Clear MWh trip counter						
T6.8.2.3	Operating days trip counter						
T6.8.2.4	Operating hours trip counter			hh:mm:ss			
T6.8.2.5	Clear operating time counter						
S6.8.3	Software info						
S6.8.3.1	Software package						
S6.8.3.2	System software version						
S6.8.3.3	Firmware interface						
S6.8.3.4	System load						
S6.8.4	Applications						
S6.8.4.#	*Name of application*						
D6.8.4.#.1	Application ID						
D6.8.4.#.2	Applications: Version						
D6.8.4.#.3	Applications: Firmware interface						
S6.8.5	Hardware						
I6.8.5.1	Info: Power unit type code						
I6.8.5.2	Info: Unit voltage			V			
I6.8.5.3	Info: Brake chopper						
I6.8.5.4	Info: Brake resistor						
S6.8.6	Expander boards						
S6.8.7	Debug menu						For Application programming only. Contact factory for more details

Table 9-5. System menu functions

9.3.6.1 Language selection

The Vacon control keypad offers you the possibility to control the frequency converter through the keypad in the language of your choice.

Locate the language selection page under the *System menu*. Its location indication is **S6.1**. Press the *Menu button right* once to enter the edit mode. As the name of the language starts to blink you are able to choose another language for the keypad texts. Confirm the selection by pushing the *Enter button* The blinking stops and all textual information on the keypad is presented in the language you chose.

You can return to the previous menu anytime by pushing the *Menu button left*.

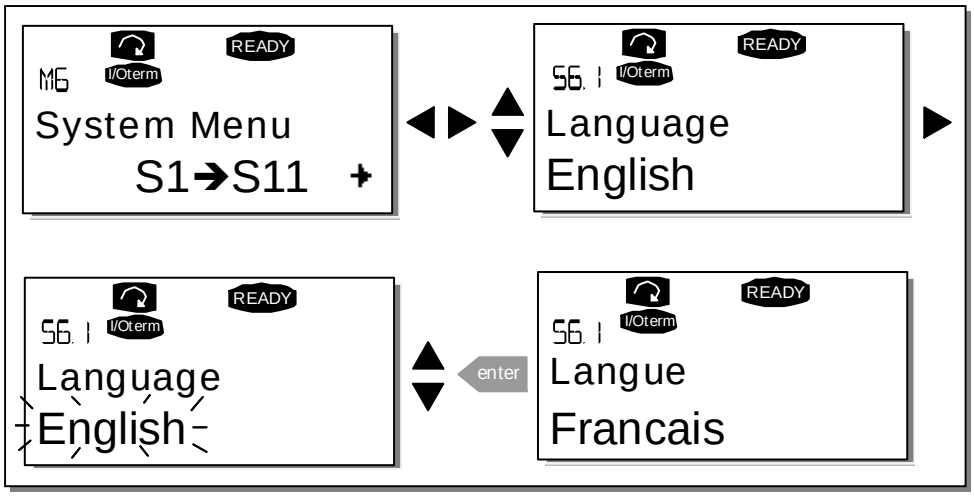

Figure 9-9. Selection of language

9.3.6.2 Application selection

The user can select the application desired by entering the *Application selection page (S6.2)*. This is done by pushing the *Menu button right* when on the first page of the *System menu*. Change then the application by pushing the *Menu button right* once again. The name of the application starts to blink. Now you can browse through the applications with the *Browser buttons* and select another application with the *Enter button*.

Changing application will reset all parameters. After application change, you will be asked if you want the parameters of the **new** application to be uploaded to the keypad. If you wish this to happen push the *Enter button* Pushing any other button leaves the parameters of the **previously used** application saved in the keypad. For more information, see Chapter 9.3.6.3.

For more information about the Application Package, see Vacon NX Application Manual.

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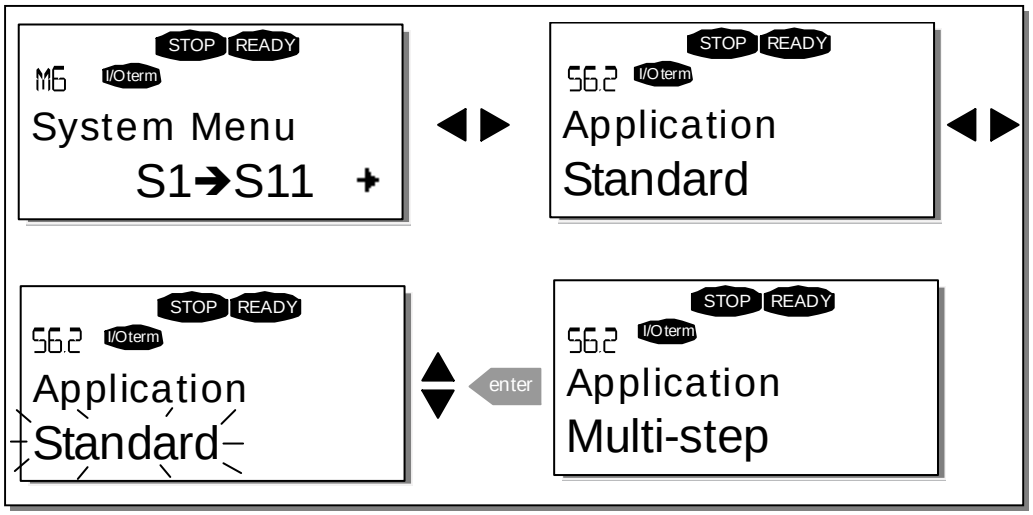

Figure 9-10. Change of application

9.3.6.3 Copy parameters

The parameter copy function is used when the operator wants to copy one or all parameter groups from one drive to another or to store parameter sets in the internal memory of the converter. All the parameter groups are first *uploaded* to the keypad, then the keypad is connected to another drive and then the parameter groups are *downloaded* to it (or possibly back to the same drive).

Before any parameters can successfully be copied from one drive to another the **drive** has to be **stopped** when the parameters are downloaded to it:

The parameter copy menu **(S6.3)** embodies four functions:

Parameter sets (S6.3.1)

The Vacon NX frequency converter features a possibility for the user to load back the factory default parameter values and to store and load two customised parameter sets (all parameters included in the application).

On *Parameter sets* page **(S6.3.1)**, push the *Menu button right* to enter the *Edit menu*. The text *LoadFactDef* begins to blink and you can confirm the loading of factory defaults by pushing the *Enter button*. The drive resets automatically.
Alternatively you can choose any other of the storing or loading functions with the *Browser buttons*. Confirm with the *Enter button*. Wait until 'OK' appears on the display.

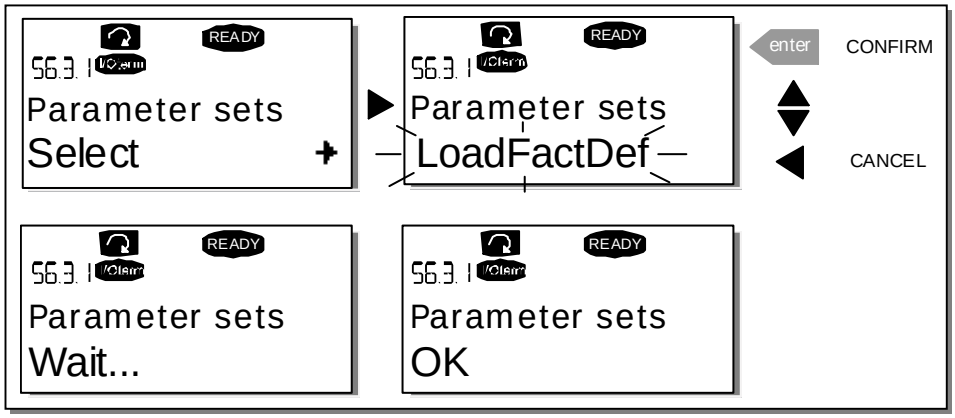

Figure 9-11. Storing and loading of parameter sets

Upload parameters to keypad (To keypad, S6.3.2)

This function uploads **all** existing parameter groups to the keypad provided that the drive is stopped.

Enter the *To keypad* page (S6.3.2) from the *Parameter copy menu*. Push the *Menu button right* to enter the edit mode. Use the *Browser buttons* to select the option *All parameters* and press the *Enter button*. Wait until 'OK' appears on the display.

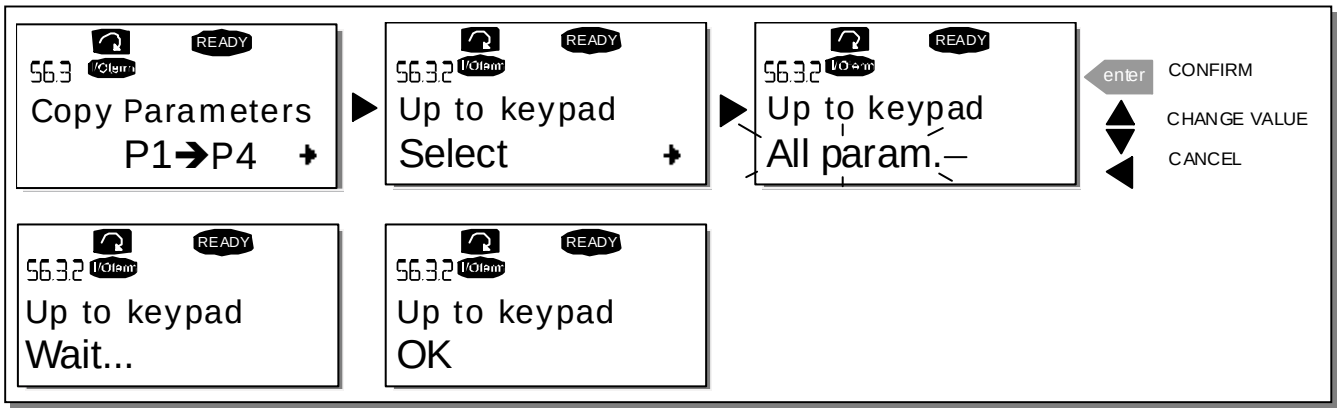

Figure 9-12. Parameter copy to keypad

Download parameters to drive (From keypad, S6.3.3)

This function downloads **one** or **all parameter** groups uploaded to the keypad to a drive provided that the drive is in STOP status.

Enter the *From keypad* page (S6.3.3) from the *Parameter copy menu*. Push the *Menu button right* to enter the edit mode. Use the *Browser buttons* to select either the option *All parameters* or *Application parameters* and press the *Enter button*. Wait until 'OK' appears on the display.

The procedure to download the parameters from keypad to drive is similar to that of from drive to keypad. See above.

Automatic parameter backup (P6.3.4)

On this page you can activate or inactivate the parameter backup function. Enter the edit mode by pressing the *Menu button right*. Choose *Yes* or *No* with the *Browser buttons*.

When the Parameter backup function is activated Vacon NX control keypad makes a copy of the parameters of the presently used application. Every time a parameter is changed the keypad backup is automatically updated.

When applications are changed, you will be asked if you wish the parameters of the **new** application to be uploaded to the keypad. For this to happen, push the *Enter button*. If you wish to keep the copy of the parameters of the **previously used** application saved in the keypad push any other button. Now you will be able to download these parameters to the drive following the instructions given in chapter 9.3.6.3.

If you want the parameters of the new application to be automatically uploaded to the keypad you have to do this for the parameters of the new application once on page 6.3.2 as instructed.
Otherwise the panel will always ask for the permission to upload the parameters.

Note: Parameters saved in the parameter settings on page **S6.3.1** will be deleted when applications are changed. If you want to transfer the parameters from one application to another you have to upload them first to the keypad.

9.3.6.4 Parameter comparison

In the *Parameter comparison* submenu **(S6.4)**, you can compare the **actual parameter values** to the values of your customised parameter sets and those loaded to the control keypad.

The comparison is performed by pushing the *Menu button right* when in the *Compare parameters submenu*. The actual parameter values are first compared to those of the customised parameter Set1. If no differences are detected a '0' is displayed on the lowermost line. But if any of the parameter values differ from those of the Set1 the number of the deviations is displayed together with symbol **P** (e.g. P1→P5 = five deviating values). By pressing the *Menu button right* once again you can still enter the pages where you can see both the actual value and the value it was compared to. In this display, the value on the Description line (in the middle) is the default value and the one on the value line (lowermost) is the edited value. Furthermore, you can also edit the actual value with the *Browser buttons* in the *edit mode* that you can reach by pushing the *Menu button right* once again.
In the same way, you can perform the comparison of the actual values to *Set2*, *Factory Settings* and *Keypad Set*.

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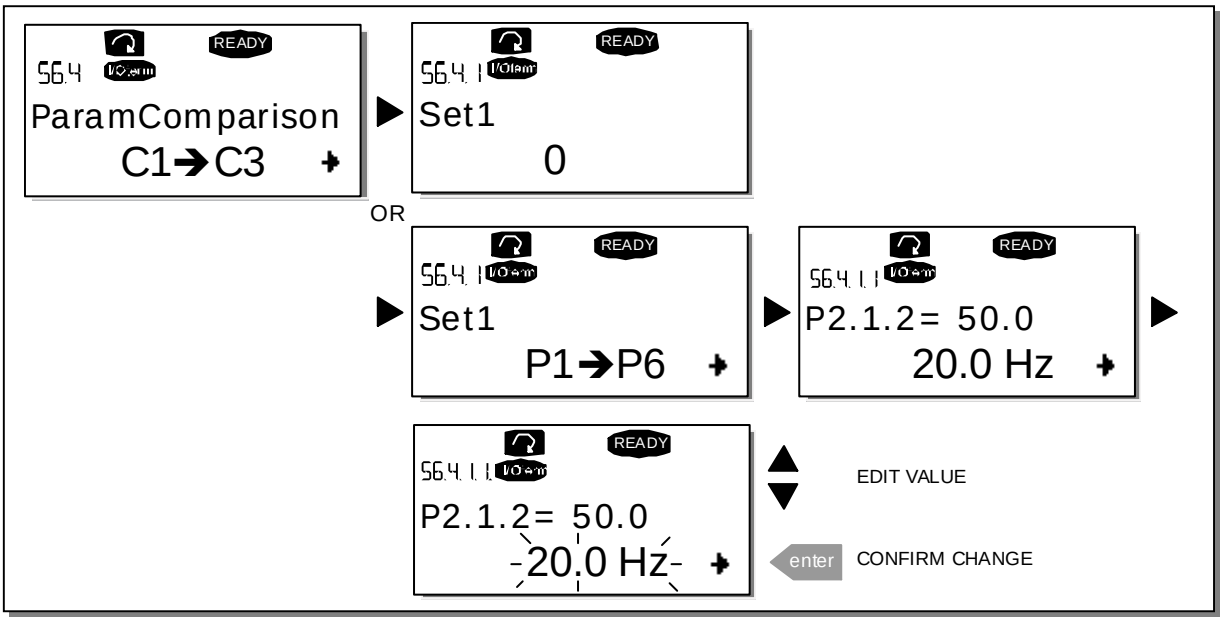

Figure 9-13. Parameter comparison

9.3.6.5 Security

NOTE: The *Security submenu* is protected with a password. Store the password in a safe place!

Password (S6.5.1)

The application selection can be protected against unauthorised changes with the Password function **(S6.5.1)**.
By default, the password function is not in use. If you want to activate the function, enter the edit mode by pushing the *Menu button right*. A blinking zero appears in the display and now you can set a password with the *Browser buttons*. The password can be any number between 1 and 65535.

Note that you can also set the password by digits. In the edit mode, push the *Menu button right* once again and another zero appears on the display. Now set first the units. Then push the Menu button left and you can set the tens etc. Finally, confirm the password setting with the *Enter button*. After this, you have to wait until the *Timeout time (P6.6.3)* (see page 87) has expired before the password function is activated.
If you now try to change applications or the password itself you will be prompted for the current password. The password will be entered with the *Browser buttons*.
Deactivate the password function by entering the value **0**.

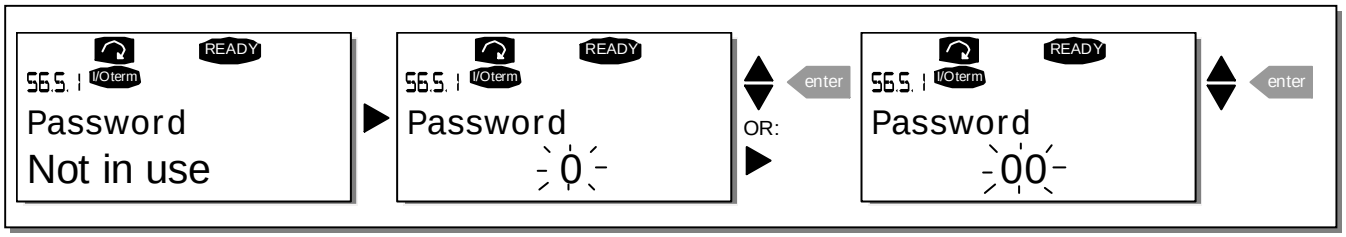

Figure 9-14. Password setting

Note! Store the password in a secure location! No changes can be made unless a valid password is entered!

Parameter lock (P6.5.2)

This function allows the user to prohibit changes to the parameters.

If the parameter lock is activated the text **locked** will appear on the display if you try to edit a parameter value.

NOTE: This function does not prevent unauthorised editing of parameter values.

Enter the edit mode by pushing the *Menu button right*. Use the *Browser buttons* to change the parameter lock status. Accept the change with the *Enter button* or return to the previous level with the *Menu button left*.

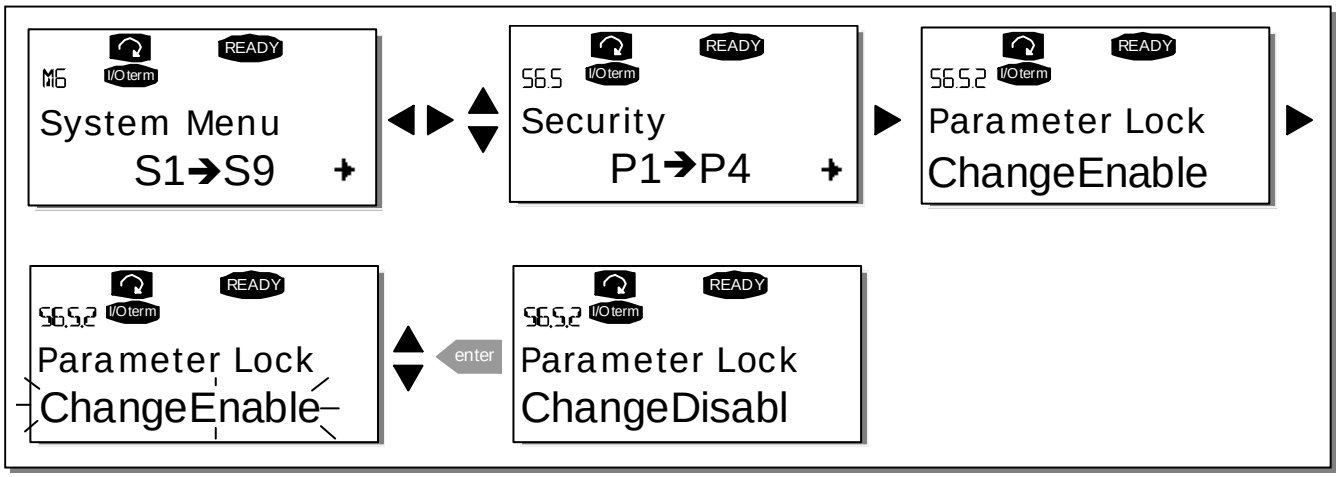

Figure 9-15. Parameter locking

Start-up Wizard (P6.5.3)

The **Start-up Wizard** is a feature on the control keypad to facilitate the commissioning of the frequency converter. If selected active (default), the Start-up Wizard prompts the operator for the **language** and **application** of his/her choice plus for **the values for a set of parameters** common to all applications as well as **for a set of application-dependent** parameters.

Always accept the value with the *Enter button*, scroll options or change values with the *Browser buttons* (up and down arrows).

Set the Start-up Wizard active in the following way: In the System Menu, find page P6.5.3. Press the *Menu button right* once to reach the edit mode. Use the *Browser buttons* to set value *Yes* and confirm the selection with the *Enter button*. If you want to deactivate the function follow the same procedure and give the parameter value *No*.

Figure 9-16. Activation of Start-up wizard

Multimonitoring items (P6.5.4)

Vacon alpha-numeric keypad features a display where you can monitor even three actual values at the same time (see chapter 9.3.1 and chapter *Monitoring values* in the manual of the application you are using). On page P6.5.4 of the System Menu you can define if it is possible for the operator to replace the values monitored with other values. See below.

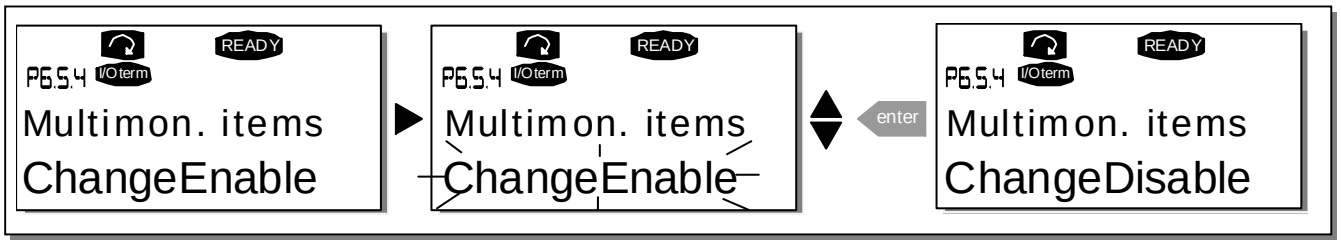

Figure 9-17. Enabling the change of multimonitoring items

9.3.6.6 Keypad settings

In the Keypad settings submenu under the *System menu* you can further customise your frequency converter operator interface.
Locate the Keypad settings submenu **(S6.6)**. Under the submenu, there are four pages **(P#)** associated with the keypad operation:

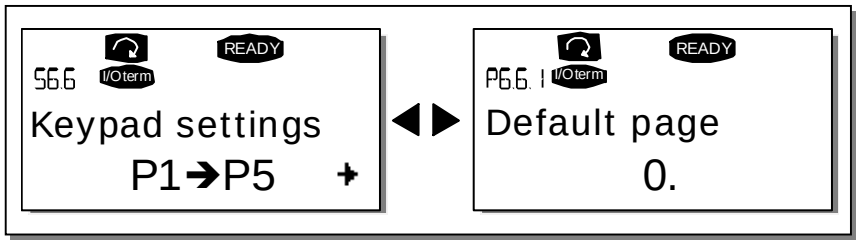

Figure 9-18. Keypad settings submenu

Default page (P6.6.1)

Here you can set the location (page) to which the display automatically moves as the *Timeout time* (see below) has expired or as the power is switched on to the keypad.

If the *Default Page* value is **0** the function is not activated, i.e. the last displayed page remains on the keypad display. Press the *Menu button right* once to enter the edit mode. Change the number of the Main menu with the *Browser buttons*. Pressing the *Menu button right* once again makes you able to edit the number of the submenu/page. If the page you want to move to by default is at the third level repeat the procedure. Confirm the new default page value with the *Enter button*. You can return to the previous step anytime by pushing the *Menu button left*.

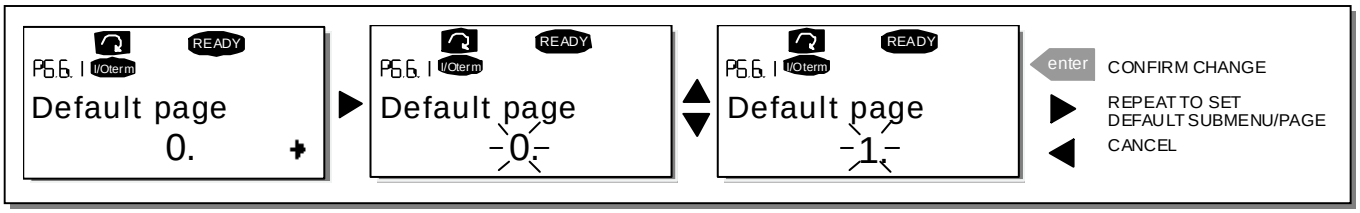

Figure 9-19. Default page function

Default page in the operating menu (P6.6.2)

Here you can set the location (page) **in the *Operating menu*** (in special applications only) to which the display automatically moves as the set *Timeout time* (see below) has expired or as the power is switched on to the keypad. See setting of Default page above.

Timeout time (P6.6.3)

The Timeout time setting defines the time after which the keypad display returns to the Default page (P6.6.1) see above.
Move to the Edit menu by pressing the *Menu button right*. Set the timeout time you want and confirm the change with the *Enter button*. You can return to the previous step anytime by pushing the *Menu button left*.

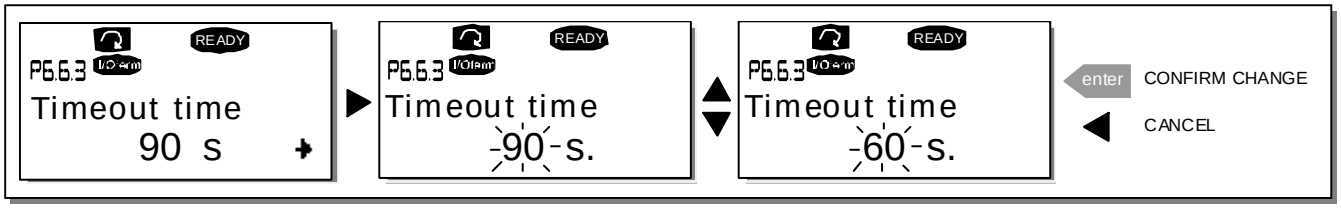

Figure 9-20. Timeout time setting

Note: If the *Default page* value is **0** the *Timeout time* setting has no effect.

Contrast adjustment (P6.6.4)

In case the display is unclear you can adjust its contrast through the same procedure as that for the timeout time setting (see above).

Backlight time (P6.6.5)

Giving a value for the *Backlight time*, you can determine how long the backlight stays on before going out. You can select here any time between 1 and 65535 minutes or *'Forever'*. For the value setting procedure see Timeout time (P6.6.3).

9.3.6.7 Hardware settings

NOTE: The *Hardware settings submenu* is protected with a password (see chapter Password (S6.5.1). Store the password in a safe place!

In the *Hardware settings submenu* **(S6.7)** under the *System menu* you can further control some functions of the hardware in your frequency converter. The functions available in this menu are ***Internal brake resistor connection, Fan control, HMI acknowledge timeout and HMI retry.***

Internal brake resistor connection (P6.7.1)

With this function you can tell the frequency converter, whether the internal brake resistor is connected or not. If you have ordered the frequency converter with an internal brake resistor, the default value of this parameter is *Connected.* However, if it is necessary to increase braking capacity by installing an external brake resistor, or if the internal brake resistor is disconnected for another reason, it is advisable to change the value of this function to *Not conn.* in order to avoid unnecessary fault trips.

Enter the edit mode by pushing the *Menu button right*. Use the *Browser buttons* to change the internal brake resistor status. Accept the change with the *Enter button* or return to the previous level with the *Menu button left*.

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Note! The brake resistor is available as optional equipment for all classes. It can be installed internally in classes FR4 to FR6.

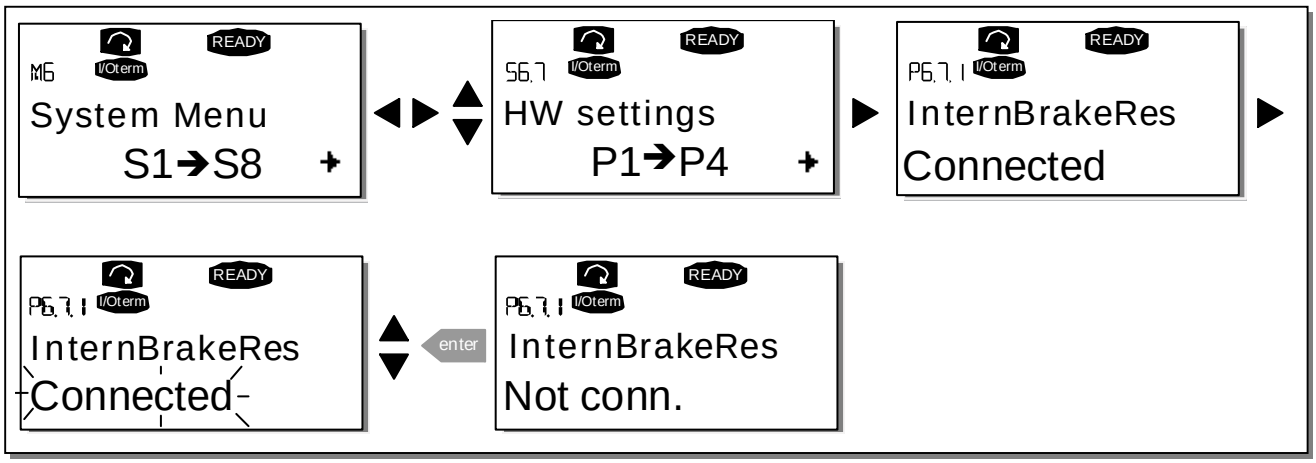

Figure 9-21. Internal brake resistor connection

Fan control (P6.7.2)

This function allows you to control the frequency converter's cooling fan. You can set the fan to run continuously when the power is switched on or depending on the temperature of the unit. If the latter function has been selected the fan is switched on automatically when the heat sink temperature reaches 60°C or the converter is in RUN state. The fan receives a stop command when the heat sink temperature falls to 55°C and the converter is in STOP state. However, the fan runs for about a minute after receiving the stop command or switching on the power, as well as after changing the value from *Continuous* to *Temperature.*

Note! The fan runs always when the drive is in RUN state.

Enter the edit mode by pushing the *Menu button right*. The present mode shown starts to blink. Use the *Browser buttons* to change the fan mode. Accept the change with the *Enter button* or return to the previous level with the *Menu button left*.

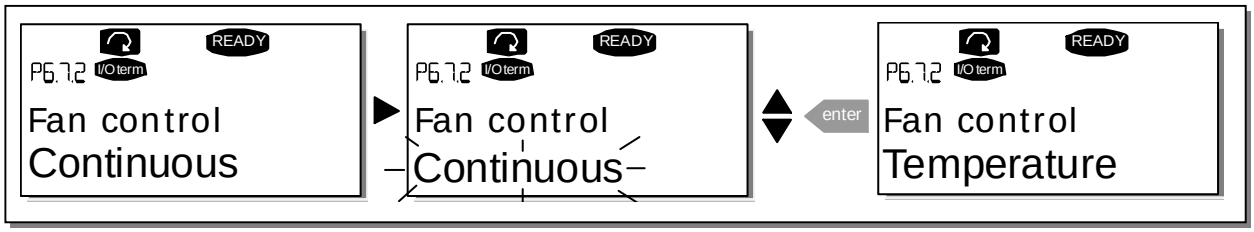

Figure 9-22. Fan control function

HMI acknowledge timeout (P6.7.3)

This function allows the user to change the timeout of the HMI acknowledgement time in cases where there is an additional delay in the RS-232 transmission due to use of modems for communication over longer distances, for example.

Note! If the frequency converter has been connected to the PC with a **normal cable**, the default values of parametres 6.7.3 and 6.7.4 (200 and 5) **must not be changed.**
If the frequency converter has been connected to the PC via a modem and there is delay in transferring messages, the value of par. 6.7.3 must be set according to the delay as follows:

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Example:

- Transfer delay between the frequency converter and the PC = 600 ms
- The value of par. 6.7.3 is set to 1200 ms (2 x 600, sending delay + receiving delay)
- The corresponding setting shall be entered in the [Misc]-part of the file NCDrive.ini:

  Retries = 5
  AckTimeOut = 1200
  TimeOut = 6000

It must also be considered that intervals shorter than the AckTimeOut-time cannot be used in NC-Drive monitoring.

Enter the edit mode by pushing the *Menu button right*. Use the *Browser buttons* to change the acknowledgement time. Accept the change with the *Enter button* or return to the previous level with the *Menu button left*.

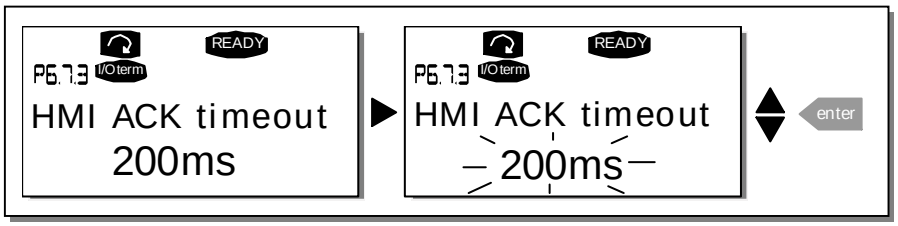

Figure 9-23. HMI acknowledge timeout

Number of retries to receive HMI acknowledgement (P6.7.4)

With this parameter you can set the number of times the drive will try receive acknowledgement if this does not succeed within the acknowledgement time (P6.7.3) or if the received acknowledgement is faulty.

Enter the edit mode by pushing the *Menu button right*. The present value shown starts to blink. Use the *Browser buttons* to change the amount of retries. Accept the change with the *Enter button* or return to the previous level with the *Menu button left*.

See Figure 9-23 for the procedure of changing the value.

9.3.6.8 System info

In the *System info submenu* **(S6.8)** you can find frequency converter-related hardware and software information as well as operation-related information.

Total counters (S6.8.1)

In the *Total counters* page **(S6.8.1)** you can find information related to the frequency converter operation times, i.e. the total numbers of MWh, operation days and operation hours passed so far. Unlike the counters in the Trip counters , these counters cannot be reset.

Note! The Power On time counter (days and hours) runs always, when the power is on.

Page	Counter	Example
C6.8.1.1.	MWh counter	
C6.8.1.2.	Power On day counter	Value on display is *1.013*. The drive has operated for 1 year and 13 days.
C6.8.1.3.	Power On hour counter	Value on display is 7:05:16. The drive has operated for 7 hours 5 minutes and 16 seconds.

Table 9-6. Counter pages

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Trip counters (S6.8.2)

Trip counters (menu **S6.8.2)** are counters the values of which can be reset i.e. restored to zero. You have the following resettable counters at your disposal. See Table 9-6 for examples.

Note! The trip counters run only when the motor is running.

Page	Counter
T6.8.2.1	MWh counter
T6.8.2.3	Operation day counter
T6.8.2.4	Operation hour counter

Table 9-7. Resettable counters

The counters can be reset on pages 6.8.2.2 *(Clear MWh counter)* and 6.8.2.5 *(Clear Operation time counter)*.

Example: When you want to reset the operation counters you should do the following:

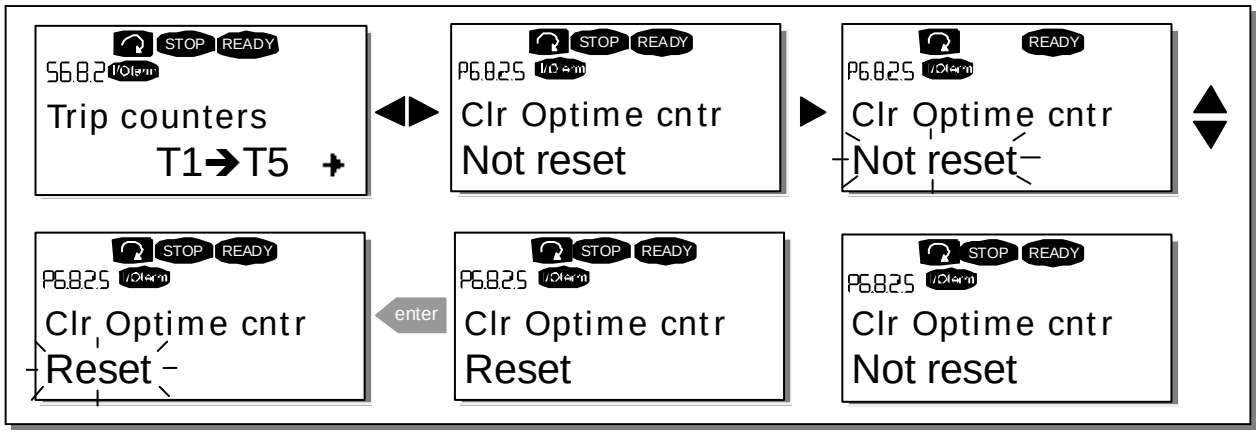

Figure 9-24. Counter reset

Software (S6.8.3)

The *Software* information page includes information on the following frequency converter software related topics:

Page	Content
6.8.3.1	Software package
6.8.3.2	System software version
6.8.3.3	Firmware interface
6.8.3.4	System load

Table 9-8. Software information pages

Applications (S6.8.4)

At location **S6.8.4** you can find the *Applications submenu* containing information about not only the application currently in use but also all other applications loaded into the frequency converter. The information available is:

Page	Content
6.8.4.#	*Name of application*
6.8.4.#.1	Application ID
6.8.4.#.2	Version
6.8.4.#.3	Firmware interface

Table 9-9. Applications information pages

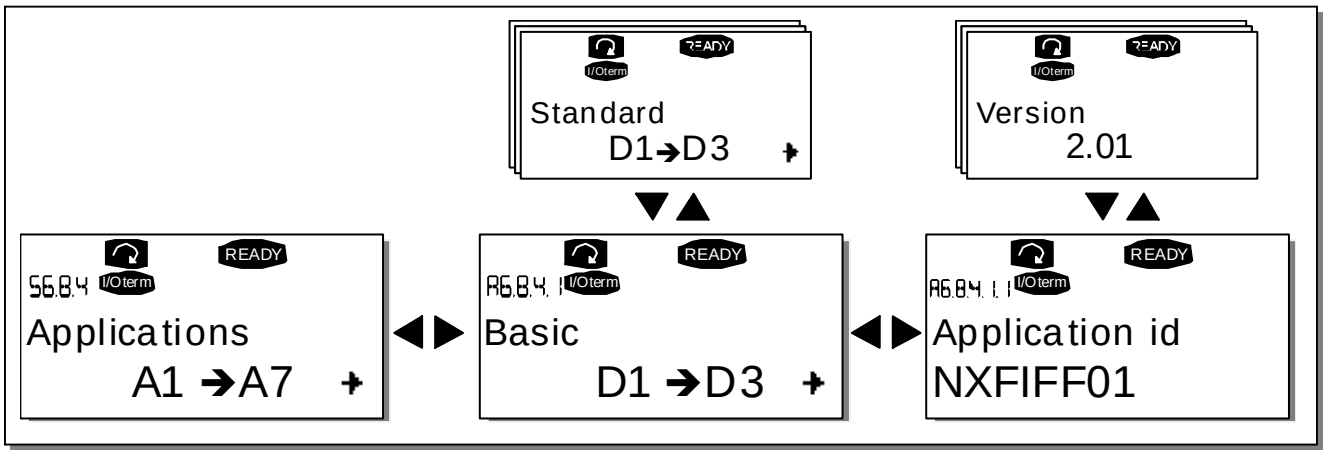

Figure 9-25. Applications info page

In the *Applications* information page, push the *Menu button right* to enter the Application pages of which there are as many as there are applications loaded into the frequency converter. Locate the application you want information about with the *Browser buttons* and then enter the *Information pages* with the *Menu button right*. Use again the *Browser buttons* to see the different pages.

Hardware (S6.8.5)

The *Hardware* information page provides information on the following hardware-related topics:

Page	Content
6.8.5.1	Nominal power of the unit
6.8.5.2	Nominal voltage of the unit
6.8.5.3	Brake chopper
6.8.5.4	Brake resistor

Table 9-10. Hardware information pages

Expander boards (S6.8.6)

In the *Expander boards* pages you find information about the basic and option boards connected to the control board (see Chapter 8.2).

You can check the status of each board slot by entering the *Expander boards* page with the *Menu button right* and using the *Browser buttons* to choose the board whose status you wish to check. Push the *Menu button right* again to display the status of the board. The keypad will also display the program version of the respective board when you push either one of the *Browser buttons*.
If no board is connected to the slot the text *'no board'* will be shown. If a board is connected to a slot but the connection is somehow lost the text *'no conn.'* is displayed. See Chapter 8.2 and Figure 8-1 and 6-16 for more information.

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For more information on the expander board-related parameters, see Chapter 9.3.7.

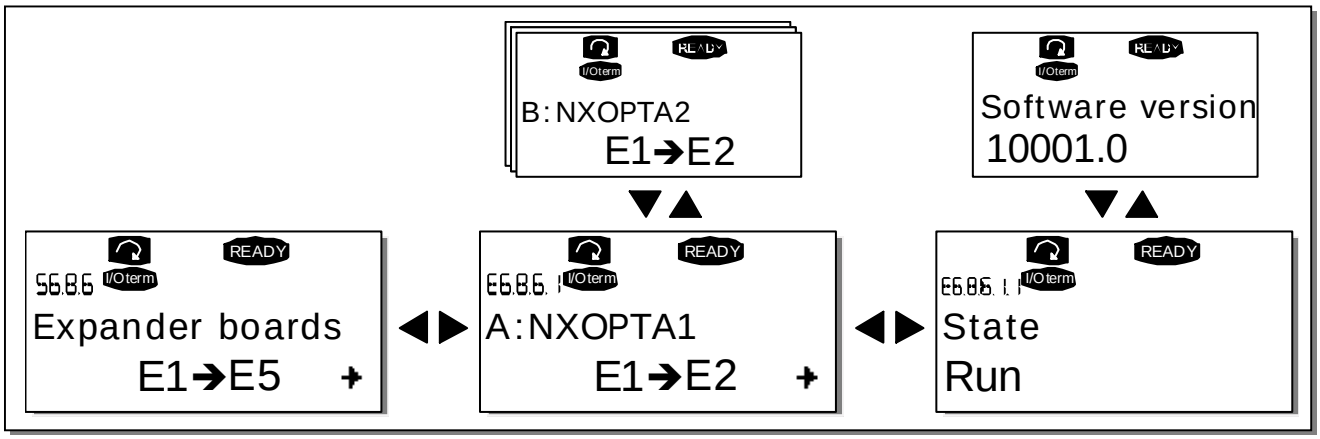

Figure 9-26. Expander board information menus

Debug menu (S6.8.7)

This menu is meant for advanced users and application designers. Contact factory for any assistance needed.

9.3.7 Expander board menu (M7)

The *Expander board menu* makes it possible for the user 1) to see what expander boards are connected to the control board and 2) to reach and edit the parameters associated with the expander board.
Enter the following menu level **(G#)** with the *Menu button right*. At this level, you can browse through slots (see page 56) A to E with the *Browser buttons* to see what expander boards are connected. On the lowermost line of the display you also see the number of parameters associated with the board. You can view and edit the parameter values in the same way as described in chapter 9.3.2. See Table 9-11 and Figure 9-27.

Expander board parameters

Code	Parameter	Min	Max	Default	Cust	Selections
P7.1.1.1	AI1 mode	1	5	3		**1**=0...20 mA **2**=4...20 mA **3**=0...10 V **4**=2...10 V **5**=–10...+10 V
P7.1.1.2	AI2 mode	1	5	1		See P7.1.1.1
P7.1.1.3	AO1 mode	1	4	1		**1**=0...20 mA **2**=4...20 mA **3**=0...10 V **4**=2...10 V

Table 9-11. Expander board parameters (board OPT-A1)

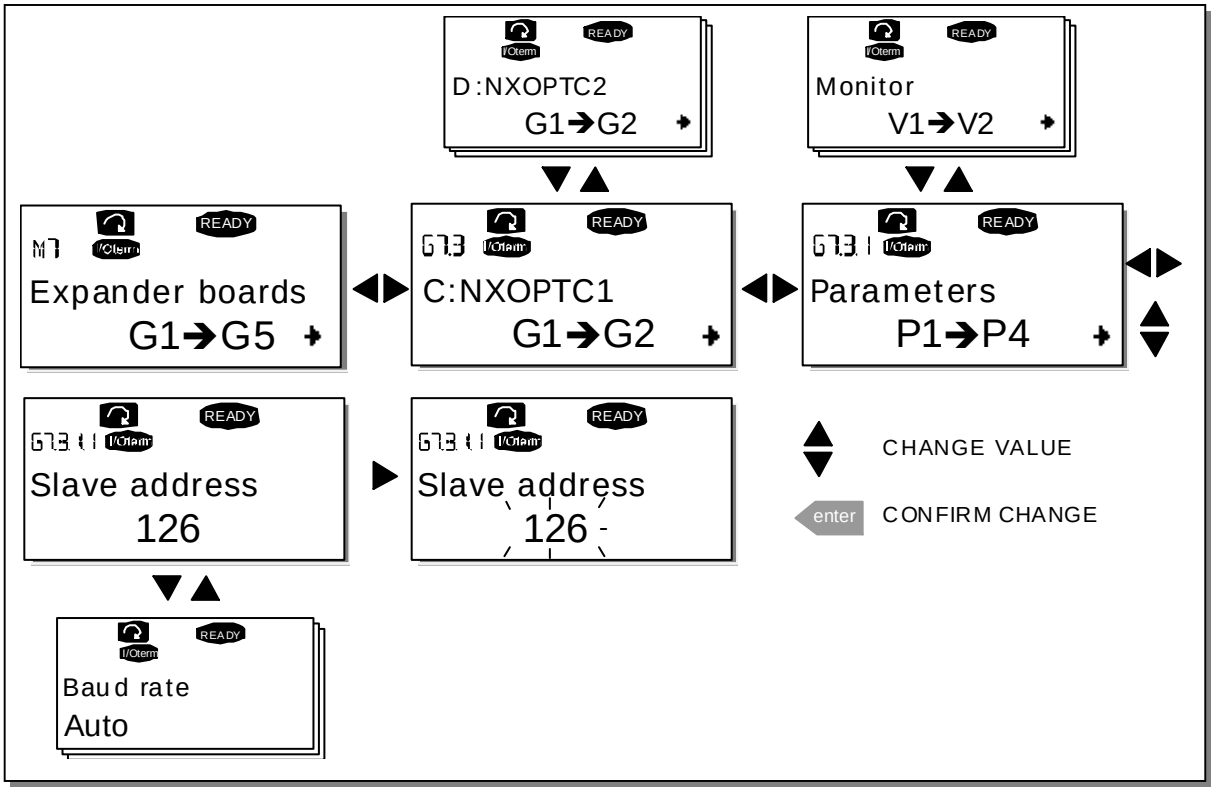

Figure 9-27. Expander board information menu

9.4 Further keypad functions

The Vacon NX control keypad embodies additional application-related functions. See Vacon NX Application Package for more information.

10. COMMISSIONING

10.1 Safety

Before commissioning, note the following directions and warnings:

1	Internal components and circuit boards of the frequency converter (except for the galvanically isolated I/O terminals) are **live** when Vacon NX is connected to mains potential. **Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.**
2	The motor terminals U, V, W and the DC-link/brake resistor terminals –/+ are **live** when Vacon NX is connected to mains, **even if the motor is not running**.
3	The control I/O-terminals are isolated from the mains potential. However, the relay outputs and other I/O-terminals may have a dangerous control voltage present even when Vacon NX is disconnected from mains.
4	Do not make any connections with the frequency converter connected to the mains.
5	After having disconnected the frequency converter from the mains, wait until the fan stops and the indicators on the keypad go out (if no keypad is attached see the indicator through the keypad base). Wait 5 more minutes before doing any work on Vacon NX connections. Do not even open the cabinet door or cover before this time has expired.
6	Before connecting the frequency converter to mains make sure that the Vacon NX front cover is closed.

10.2 Commissioning of the frequency converter

1 Read carefully the safety instructions in Chapter 1 and above and follow them.

2 After the installation, pay attention to:

- that both the frequency converter and the motor are grounded.
- that the mains and motor cables comply with the requirements given in Chapter 6.2.4.
- that the control cables are located as far as possible from the power cables (see Chapter 7, step 3) , the shields of the shielded cables are connected to protective earth ⏚. The wires may not touch the electrical components of the frequency converter.
- that the common inputs of digital input groups are connected to +24V or ground of the I/O terminal or the external supply.

3 Check the quality and quantity of cooling air (chapter 5.2 and Table 5-4).

4 Check the inside of the frequency converter for condensation.

5 Check that all Start/Stop switches connected to the I/O terminals are in **Stop**-position.

6 Connect the frequency converter to mains.

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7 Set the parameters of group 1 (See Vacon All in One Application Manual) according to the requirements of your application. At least the following parameters should be set:

- motor nominal voltage
- motor nominal frequency
- motor nominal speed
- motor nominal current

You will find the values needed for the parameters on the motor rating plate.

8 Perform run test **without motor**

Perform either Test A or Test B:

***A** Controls from the I/O terminals:*

a) Turn the Start/Stop switch to ON position.

b) Change the frequency reference

*c) Check in the Monitoring menu **M1** that the value of Output frequency changes according to the change of frequency reference.*

d) Turn the Start/Stop switch to OFF position.

***B** Control from the control keypad:*

a) Change the control from the I/O terminals to the keypad as advised in Chapter 9.3.3.1.

b) Push the Start button on the keypad

.

*c) Move over to the Keypad control menu **(M3)** and Keypad Reference submenu (Chapter 9.3.3.2) and change the frequency reference using the Browser buttons*

.

*d) Check in the Monitoring menu **M1** that the value of Output frequency changes according to the change of frequency reference.*

e) Push the Stop button on the keypad

.

9 Run the start-up tests without the motor being connected to the process, if possible. If this is not possible, secure the safety of each test prior to running it. Inform your co-workers of the tests.

a) Switch off the supply voltage and wait up until the drive has stopped as advised at Chapter 10.1, step 5.

b) Connect the motor cable to the motor and to the motor cable terminals of the frequency converter.

c) See to that all Start/Stop switches are in Stop positions.

d) Switch the mains ON

*e) Repeat test **8A** or **8B**.*

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10 Connect the motor to the process (if the startup test was run without the motor being connected)

a) Before running the tests, make sure that this can be done safely.

b) Inform your co-workers of the tests.

*c) Repeat test **8A** or **8B**.*

11. FAULT TRACING

The fault codes, their causes and correcting actions are presented in Table 11-2 below. The converter has an internal memory for storing the converter status at the time of fault as well as additional information about the source of the fault. This feature is intended to help the user or the service personnel to determine the cause of fault.

11.1 Fault time data record

When a fault occurs a fault code is displayed on the keypad. By pushing the *Menu button right* here you will enter the *Fault time data record menu* indicated by **T.1→T.16**. In this menu, some selected important data valid at the time of the fault are recorded.

T.1	Operation days	D
T.2	Operation hours	hh:mm:ss
T.3	Output frequency	Hz
T.4	Motor current	A
T.5	Motor voltage	V
T.6	Motor power	%
T.7	Motor torque	%
T.8	DC voltage	V
T.9	Unit temperature	°C
T.10	Run status	
T.11	Direction	
T.12	Warnings	
T.13	0-speed*	
T.14	*Subcode.* Contains more specific information about the fault. **S1...S#:** System generated fault. See fault table below. **A1:** Application generated fault. See table below or application-specific documentation.	
T.15	*Module code*. Indicates where the fault was detected. **Power:** Power unit of the converter (sizes up to FR11) **Power1:** First power unit in a parallel converter (e.g. in FR12) **Power2:** Second power unit in a parallel converter (e.g. in FR12) **Control:** Control part or control part communication **Expander:** Expander board or expander board communication **Adapter:** Adapter board or adapter board communication **Starcoupler:** Starcoupler board (parallel unit only, e.g. FR12) **Motor:** Motor-related problem **Software:** Application software	
T.16	*Module subcode.* Indicates the source for the problem within the Module indicated in **T.15.** **Unit:** Cause of problem in unit, not specified **Board:** Problem in PCB or communication with PCB **U-Phase:** Fault origin in the U-phase **V-Phase:** Fault origin in the V-phase **W-Phase:** Fault origin in the W-phase **Slot A-E:** Fault origin in the slot indicated by A, B, C, D or E **Application:** Fault in application	

Table 11-1. Fault time recorded data

* Tells the user if the drive was at zero speed (< 0.01 Hz) when the fault occurred

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Real time record

If real time is set to run on the frequency converter the data items **T1** and **T2** will appear as follows:

T.1	Date	yyyy-mm-dd
T.2	Time	hh:mm:ss,sss

Note: When contacting your Vacon partner because of a fault condition, always write down all texts and codes on the keypad display before.

11.2 Fault codes

The fault codes, their causes and correcting actions are presented in the table below. The shadowed faults are A faults only. The items written in white on black background present faults for which you can program different responses in the application. See parameter group Protections.
Note: When contacting distributor or factory because of a fault condition, always write down all texts and codes on the keypad display.

Fault code	Fault	Possible cause	Correcting measures
1	Overcurrent	Frequency converter has detected too high a current (>4*I_H) in the motor cable: – sudden heavy load increase – short circuit in motor cables – unsuitable motor Subcode in **T.14:** S1 = Hardware trip S2 = Current cutter supervision (NXS) S3 = Current controller supervision	Check loading. Check motor. Check cables.
2	Overvoltage	The DC-link voltage has exceeded the limits defined in Table 4-5. – too short a deceleration time – high overvoltage spikes in supply Subcode in **T.14:** S1 = Hardware trip S2 = Overvoltage control supervision	Make the deceleration time longer. Use brake chopper or brake resistor (available as options)
3	Earth fault	Current measurement has detected that the sum of motor phase current is not zero. – insulation failure in cables or motor	Check motor cables and motor.
5	Charging switch	The charging switch is open, when the START command has been given. – faulty operation – component failure	Reset the fault and restart. Should the fault re-occur, contact your local distributor.
6	Emergency stop	Stop signal has been given from the option board.	Check emergency stop circuit
7	Saturation trip	Various causes: – defective component – brake resistor short-circuit or overload	Cannot be reset from the keypad. Switch off power. DO NOT RE-CONNECT POWER! Contact your local distributor. If this fault appears simultaneously with Fault 1, check motor cables and motor

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8	System fault	- component failure - faulty operation Note exceptional fault data record Subcode in **T.14:** S1 = Feedback of motor voltage S2 = Reserved S3 = Reserved S4 = ASIC trip S5 = Disturbance in VaconBus S6 = Feedback of charging switch S7 = Charging switch S8 = No power to driver card S9 = Power unit communication (TX) S10 = Power unit communication (Trip) S11 = Power unit comm. (Measurement)	Reset the fault and restart. Should the fault re-occur, contact your local distributor.
9	Undervoltage	DC-link voltage is under the voltage limits defined in Table 4-5. – most probable cause: too low a supply voltage – frequency converter internal fault Subcode in **T.14:** S1 = DC-link too low during run S2 = No data from power unit S3 = Undervoltage control supervision	In case of temporary supply voltage break, reset the fault and restart the frequency converter. Check the supply voltage. If it is adequate, an internal failure has occurred. Contact your local distributor.
10	Input line supervision	Input line phase is missing. Subcode in **T.14:** S1 = Phase supervision diode supply S2 = Phase supervision active front end	Check supply voltage, fuses and cable.
11	Output phase supervision	Current measurement has detected that there is no current in one motor phase.	Check motor cable and motor.
12	Brake chopper supervision	– no brake resistor installed – brake resistor is broken – brake chopper failure	Check brake resistor and cabling. If ok, the chopper is faulty. Contact your local distributor.
13	Frequency converter under-temperature	Heatsink temperature is under –10°C	
14	Frequency converter over-temperature	Heatsink temperature is over 90°C Overtemperature warning is issued when the heatsink temperature exceeds 85°C. S1 = Measurement S2 = Internal thermistor	Check the correct amount and flow of cooling air. Check the heatsink for dust. Check the ambient temperature. Make sure that the switching frequency is not too high in relation to ambient temperature and motor load.
15	Motor stalled	Motor stall protection has tripped.	Check motor and load.
16	Motor over-temperature	Motor overheating has been detected by frequency converter motor temperature model. Motor is overloaded.	Decrease the motor load. If no motor overload exists, check the temperature model parameters.
17	Motor underload	Motor underload protection has tripped.	Check load.

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18	Unbalance (Warning only)	Unbalance between power modules in paralleled units. Subcode in **T.14:** S1 = Current unbalance S2 = DC-Voltage unbalance	Should the fault re-occur, contact your local distributor.
22	EEPROM checksum fault	Parameter save fault – faulty operation – component failure	Should the fault re-occur, contact your local distributor.
24	Counter fault	Values displayed on counters are incorrect	Have a critical attitude towards values shown on counters.
25	Microprocessor watchdog fault	– faulty operation – component failure	Reset the fault and restart. Should the fault re-occur, contact your local distributor.
26	Start-up prevented	Start-up of the drive has been prevented.	Cancel prevention of start-up if this can be done safely.
29	Thermistor fault	The thermistor input of option board has detected too high a motor temperature	Check motor cooling and loading Check thermistor connection (If thermistor input of the option board is not in use it has to be short circuited)
31	IGBT temperature (hardware)	IGBT Inverter Bridge overtemperature protection has detected too high a short term overload current	Check loading. Check motor size.
32	Fan cooling	Cooling fan of the frequency converter does not start, when ON command is given	Contact your local distributor.
34	CAN bus communication	Sent message not acknowledged.	Ensure that there is another device on the bus with the same configuration.
35	Application	Problem in application software	Contact your distributor. If you are application programmer check the application program.
37	Device changed (same type)	Option board or power unit changed. New device of same type and rating.	Reset. Device is ready for use. Old parameter settings will be used.
38	Device added (same type)	Option board added.	Reset. Device is ready for use. Old board settings will be used.
39	Device removed	Option board removed.	Reset. Device no longer available.
40	Device unknown	Unknown option board or drive. Subcode in **T.14:** S1 = Unknown device S2 = Power1 not same type as Power2 S3 = NXS or NXP1 and star coupler S4 = Software and ctrl unit incompatible S5 = Old control board version	Contact the distributor near to you.
41	IGBT temperature	IGBT Inverter Bridge overtemperature protection has detected too high a short term overload current	Check loading. Check motor size.
42	Brake resistor overtemperature		

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43	Encoder fault	Problem detected in encoder signals. Sub code in **T.14:** S1 =Encoder 1 channel A is missing S2 =Encoder 1 channel B is missing S3 =Both enc. 1 channels are missing S4 =Encoder reversed S5 =Encoder board missing S6 = Serial communication fault S7 = Channel A/Channel B mismatch S8 = Resolver/Motor pole pair mismatch S9 = Missed start angle	Check encoder channel connections. Check the encoder board.
44	Device changed (different type)	Option board or power unit changed. New device of different type or different rating than the previous one.	Reset Set the option board parameters again if option bard changed. Set converter parameters again if power unit changed.
45	Device added (different type)	Option board of different type added.	Reset Set the option board parameters again.
49	Div by zero in application	A division by zero has occurred in the application program.	Contact your distributor. If you are application programmer check the application program.
50	Analogue input I_{in} < 4mA (sel. signal range 4 to 20 mA)	Current at the analogue input is < 4mA. – control cable is broken or loose – signal source has failed	Check the current loop circuitry.
51	External fault	Digital input fault.	
52	Keypad communication fault	The connection between the control keypad and the frequency converter is broken.	Check keypad connection and possible keypad cable.
53	Fieldbus fault	The data connection between the fieldbus Master and the fieldbus board is broken	Check installation. If installation is correct contact the nearest Vacon distributor.
54	Slot fault	Defective option board or slot	Check board and slot. Contact the nearest Vacon distributor.
56	PT100 board temp. fault	Temperature limit values set for the PT100 board parameters have been exceeded	Find the cause of temperature rise

Table 11-2. Fault codes

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